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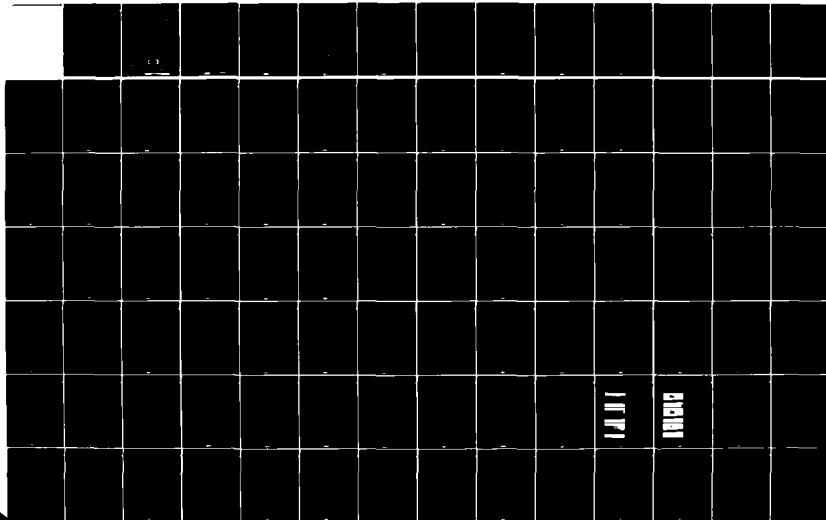
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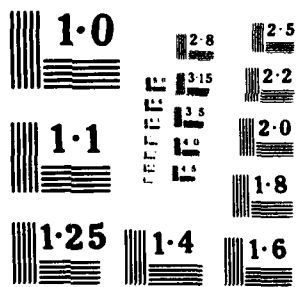
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**DAVID W. TAYLOR NAVAL SHIP  
RESEARCH AND DEVELOPMENT CENTER**

Bethesda, Maryland 20884



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**FINGER MATERIALS FOR AIR CUSHION VEHICLES VOLUME I:  
FLEXIBLE COATINGS FOR FINGER MATERIALS**

by

Paul K. Conn and Ivan Snell  
Bell Aerospace Textron

and

William Klemens, DTNSRDC

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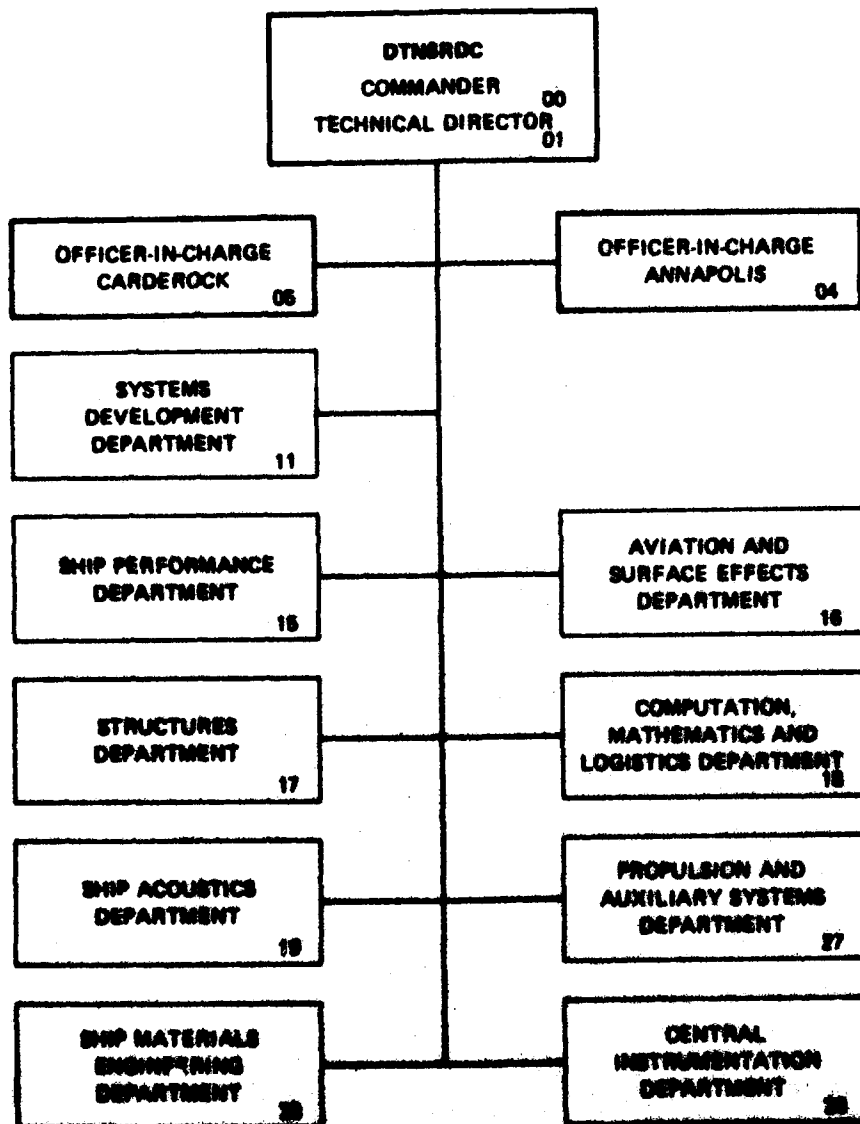
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1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research. It also provides a brief overview of the methodology used in the study.

2. The second part of the report is a detailed description of the study area. It includes information about the location of the study area, the population of the study area, and the characteristics of the study area. It also discusses the data sources used in the study.

3. The third part of the report is a description of the methodology used in the study. It includes information about the research design, the data collection methods, and the data analysis methods. It also discusses the limitations of the study.

4. The fourth part of the report is a description of the results of the study. It includes information about the findings of the study, the conclusions drawn from the findings, and the implications of the findings. It also discusses the strengths and weaknesses of the study.

5. The fifth part of the report is a conclusion and recommendations. It summarizes the findings of the study and provides recommendations for future research. It also discusses the overall impact of the study and the contributions of the study to the field of study.

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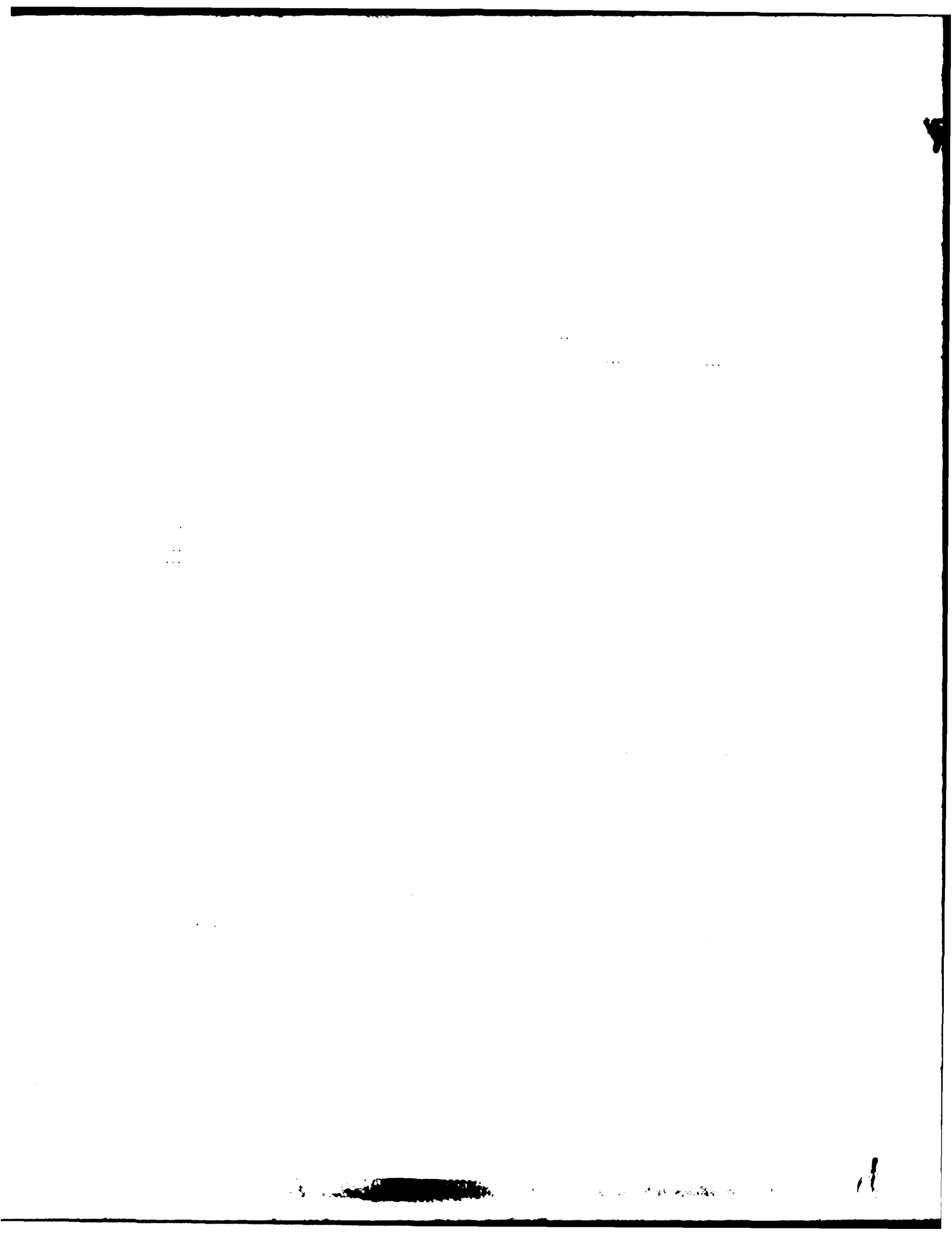
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diisopropylene oxide polymer and was ineffective with the chlorinated polyethylene polymer. This is contrary to published results for a natural rubber-SBR-butadiene blend.\* The concentration used has not yet been best for the particular polymers.

The crack growth and flexural fatigue results for the castable liquid polymer formulations are summarized in Table 4. These formulations were prepared by reacting high molecular weight hydroxy-terminated polyethers, polyacrylates or polybutadienes with a catalyst to effect crosslinking; the prepolymer resulting from these reactions were cured subsequently with either a low molecular weight hydroxy-terminated hydrocarbon or a diamine as discussed in Appendix B. In several instances, a reactive phenol was added to the polymer. These particular formulations had suitable solubility kinetics for casting, and crack growth and flexural fatigue specimens were cut in the appropriate mold immediately after curing and deaerating the blend. The formulations were cured at room temperature for several days prior to testing; a number of the formulations were post-cured at 150°C (312°F) for 24 hr. before testing at room temperature only.

The results in Table 4 show that 11 of the 13 formulations had better crack growth resistance than the standard BAI-100, and two (FCB-180, PB-190, PB-198, and FCB-190) were substantially better. In contrast, only one of the formulations (PB-198) had better flexural fatigue resistance, and two (FCB-190 and FCB-180) had approximately the same flexural fatigue resistance as the standard. The results of the preliminary screening tests, for rubber formulations BAI-100, BAI-101, BAI-102, BAI-103, BAI-104, BAI-105, and BAI-109, and castable liquid polyurethane formulations FCB-180, PB-180, PB-198, and PB-199, were selected for characterization and for primary and secondary characterization tests listed in Appendix C.

Results from the primary characterization tests of the polymer formulations are summarized in the next four tables. In Table 5 are summarized the hardness, tensile properties, tear properties, pier-abrasion index, and coating adhesion. Values for the tear and property hysteretic tests, as measured on the Goodrich Flexometer, are summarized in Table 6. Resilience is summarized in Table 7 for the Tapko rebound method and in Table 8 for the Yerzley method. In these tables, the results for the polymers are compared to results for the control formulation, FCB-300.

\*Ward, G.G., Lohan, R.D., "Effects of Molybdenum Disulfide on Elastomer Flex Life and Other Properties," paper presented at a meeting of the Rubber Division, American Chemical Society, New Orleans, LA (7-19 Oct. 1970).

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$$N_{\text{eff}} = 1.96 \pm 0.05 \quad \text{for } \sigma_{\text{eff}} = 0.0001 \quad \text{and } \sigma_{\text{eff}} = 0.0002$$
[illegible]

Two different types of wax were used in the experiments: 1) a hard paraffin wax (Candelin 100) and 2) a soft paraffin wax (Candelin 1000). The paraffin waxes were prepared by hydrogenating vegetable oils. The hard paraffin wax was used to prepare the wax film for the wax-coated paper and the soft paraffin wax was used to prepare the wax film for the wax-coated rubber. The wax formulations were selected after a series of tests and the wax-coated paper and the wax-coated rubber formulations were selected for the wax-coated paper and the wax-coated rubber formulation tests. Finally, two formulations were selected for the wax-coated paper and the wax-coated rubber formulation tests.

The authors thank a number of institutions for assistance in obtaining results for the 1995 rubber cupulation experiments and in obtaining Table 1. A more detailed listing of the experimental results is represented in Appendix 1. The formulations were developed and prepared by a commercial rubber manufacturer, or with the assistance of customers, setting out the composition of the stocks were varied at the recommended cure conditions in appropriate molds. The control formulation (B-0) was mixed by a commercial company; the cure was based on the rheometer data obtained on the mix.

#### RESULTS OF EXPERIMENTAL WORK

Fingers on air cushion vehicles are subjected to very high frequencies of vibration for example, 200 cps at relatively large amplitudes. When rubber coated fabrics are subjected to cyclic stresses through repeated or intermittent flexing, the development of cracks in the coating and delamination from the fabric become frequent causes of failure. During rapid flexing, the ability to sustain rapid strain rates and rapid strain recovery rates without crack formation is important. At high rates of flexing, heat build-up may occur so that high temperature (60-100°C) (14-212°F) properties may be important.

Desirable properties of polymer coatings have been inferred from current knowledge of the seal motions and observed damage. The polymer coating should have high flexural, compressive, and tensile fatigue resistance; high flex crack and crack growth resistance; low flexural modulus; high impact resistance; high abrasion resistance; high tear strength; low hysteresis or excellent high temperature properties; high bond strength to itself and to nylon fabric reinforcement; and resistance to environmental resistance (water, sunlight, ozone, fuel).

The principal criteria for evaluation of the polymers were comparisons of measured properties to the measured properties of known materials which had service applications. In the case of gum rubber polymers, the known material was a natural/ synthetic rubber blend formulation which was developed by Bell Aerospace Textcon on another program and designated PCB-101. This formulation was coated on woven nylon fabric and used successfully as bow and side fingers on the British SR.71 cross lander used by the Army LACV-3 amphibious air cushion vehicle. Among elastomeric polyurethanes, the known material was a polyurethane formulation developed by Bell Aerospace Textcon and designated KM-100. This formulation was coated on woven nylon fabric and used successfully as side fingers on an Army LACV-30. The woven nylon fabric used with the two different rubber coatings for the LACV-30 fingers had the same weight and configuration, and was designated fabric 178b.\* This fabric is a 10 x basket weave of 11 oz yd<sup>2</sup> and was also used as the fabric in this program.

The work is reported under three tasks and five appendices. The experimental results are summarized and discussed in this section. The rationale for polymer

\*Woven by Fabric Development Laboratory, Quakertown, PA.



#### INTRODUCTION

Surface effect ships and air cushion vehicles require a flexible seal or skirt structure to contain the cushion of air in which the craft is supported. The flexibility is necessary to minimize contact (reduce drag) between the vehicle structure and the surface being traversed, which is normally various types of ground terrain or water.

The flexible seals of these craft have typically been fabricated from rubber coated woven fabric laminate materials which were developed originally for applications such as conveyor belts and liquid storage containers. The air cushion craft are exposed to dynamic environments that are more demanding than those for the original applications. These more demanding requirements result from increased mechanical loads, from increased rate of load application, and from environmental extremes which may lead to intolerable or undesirable chemical and physical changes. Hence, substantial improvements of these flexible materials are required to provide adequate structural performance and long operational life with minimum weight and maintenance.

The objective of this program was to develop optimum rubber coatings for flexible seal/skirt applications for surface effect ships and vehicles. The primary emphasis was on gum rubber formulations based on selected synthetic rubber polymers and unstable liquid polyurethane polymers for use as woven fabric coatings. The program included a thermally conductive formulation, formulations for use without reinforcement (homogeneous materials), reinforcements other than woven fabrics, and evaluation of rubber coated fabrics.

Rubber formulations were initially evaluated alone, and then as coatings on nylon fabric. The evaluations were performed by using standard ASTM tests for selected mechanical properties. Since no correlation had been established between standard mechanical properties and service life on a vehicle, the evaluations were accomplished by comparing results from the experimental materials to results obtained from an existing natural/butadiene rubber blend coated nylon fabric which had been used successfully on an Army LACV-30 air cushion vehicle. Test pieces and sample materials were fabricated for evaluation by Bell Aerospace Textron and the DTNSRDC Annapolis Laboratory.

## FOREWORD

The high speed and versatility of Air Cushion Vehicles (ACV) offer significant potential for military applications. However, in amphibious transit over land and water, the lower appendages, called fingers, are subjected to severe flexing and churning, shortening the life of the finger. As a result, craft performance is hampered and life cycle cost increase. The objective of this exploratory development project was to develop sufficient information on fabric and coatings to guide development and selection of coated fabrics as finger materials for Navy air cushion craft.

This volume, the first of three, describes a comprehensive evaluation of candidate finger materials for air cushion vehicles. The approach taken, in which materials were screened in preliminary dynamic tests in order to identify candidates for further research, was a sensible and economic approach. Basically, in this work, the fabric was held constant and the coating was varied. Volume II of this publication describes the effect from fabric structure on the performance of finger materials, where, the coating was held constant and the fabric was varied. A natural rubber/polybutadiene blend coating was common to both endeavors and served as a reference control tying both efforts together. Volume III (to be published) describes the coated fabric as a finger material. Performance was measured at the contractor's dynamic testing facility called the "Shrimp Tank" and in the traction operation of air cushion vehicles. The information generated from Volume II was used to define coated fabric constructions which were subsequently fabricated and tested as detailed in the third volume.

Testing and evaluation performed after completion of the work reported here has shown that natural rubber/polybutadiene blend formulations. This is because these coatings have offered the greatest resistance to fatigue. Although, this report contains results which indicate that natural rubber/polybutadiene blend formulations do not necessarily offer the greatest resistance to fatigue. No correlation has been noted between those results reported here and the subsequent testing.

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$$V_1 = \frac{1}{\sqrt{2}}(V_{x_1} + V_{y_1}), \quad V_2 = \frac{1}{\sqrt{2}}(V_{x_1} - V_{y_1}).$$

*Journal of Management Education* 30(6)p.789-806

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## ABSTRACT

Twenty polymer formulations from ten selected gum rubber polymers or polymer blends and fourteen formulations of castable liquid polyurethane polymers were characterized as coatings for the coated fabric that is the type material used to make flexible fingers for air cushion vehicles. The formulations were screened for crack growth and flexural fatigue resistance; the results were compared to results from a natural rubber control formulation. The results showed that the polyurethane polymers were superior to the gum rubber polymers in both crack growth and flexural fatigue resistance.

In addition, selected polymers were evaluated with seismic and secondary characterization tests, and the results compared to results from the control formulation. One polymer also was used to evaluate the use of a carbonated carbon black to improve thermal conductivity. Finally, five of the polymer formulations and the control material were applied to cotton fabric and evaluated.

Several polymers had better crack growth resistance and/or better flexural fatigue resistance than the control polymer. A carbonated polyurethane polymer coated on nylon fabric had properties equivalent to the control polymer coated on nylon fabric. Hysteresis tests at different rates of deformation yielded results which suggested that the standard tests were not identical. Polymers with improved performance on air cushion vehicles. Two polymer-coated woven fabric materials exhibited significantly lower tensile strength at 100°C than at 20°C.

Woven fabric, knit, and knit structures were evaluated as reinforcement for polymer coating; the knit reinforcement were not as efficient in increasing the tensile strength as woven fabrics. Castable polymers were evaluated as a homogeneous material without a fiber reinforcement and were found to exhibit poor crack growth and flexural fatigue resistance.

Resilience results on the polymers (Verzley method) are given in Table 6. In this test, an initial 2% compressive deformation is applied to the specimens; upon release, the specimen begins a train of cycles, which decays due to hysteresis. The results suggest that, in partial agreement with the Lupke results, one chlorinated polyethylene (BAL-45), is similar to the control formulation ECB-01; the similarity exists in resilience (energy recovered) but not in the speed of rebound, for which BAL-45 exhibited a greater speed of recovery. The remaining gum rubber polymers exhibited less resilience than the control with recovery times both faster and slower than the control speed. Two of the polyurethanes (PU-183 and -203) exhibited excellent response and rates of recovery all greater than the control; the remaining two polyurethanes (PU-185 and -198) straddled the control both in resilience and rate of recovery, although the polymer with the higher resilience had the lower rate of recovery.

In all three of these dynamic tests, polymer deformation is compressive; indeed, Rheometer is forced high cyclic rate compression-compression, Lupke rebound is a single cycle compression, and the Verzley rebound is a multiple cycle compressive deformation with the cyclic rate and number of cycles controlled by the viscoelastic properties of the polymer. Since polymer coatings on the seals of air-cushion vehicles are subjected to high cyclic rate and concurrent large displacement tensile-tension, tension-compression, and compression-compression cyclic stresses, results from the coefficient of friction test may be the most important of the three tests. High cyclic rate, large displacement tensile-tension fatigue tests also could have been done but these tests were beyond the scope of the program.

Thermal conductivity of three formulations was measured at each of two different temperatures to evaluate the use of a reticulated carbon black to increase the thermal conductivity of polymer formulations. The three formulations were styrene-butadiene-butadiene-styrene black copolymer (SEBS) with 2 parts per hundred parts rubber (pphr) antioxidant 702, and 2 pphr Thionin 32; the same black copolymer formulation with 2 pphr Ketjenblack EC; and the control formulation ECB-01.

The thermal conductivity results are presented in Table 7.





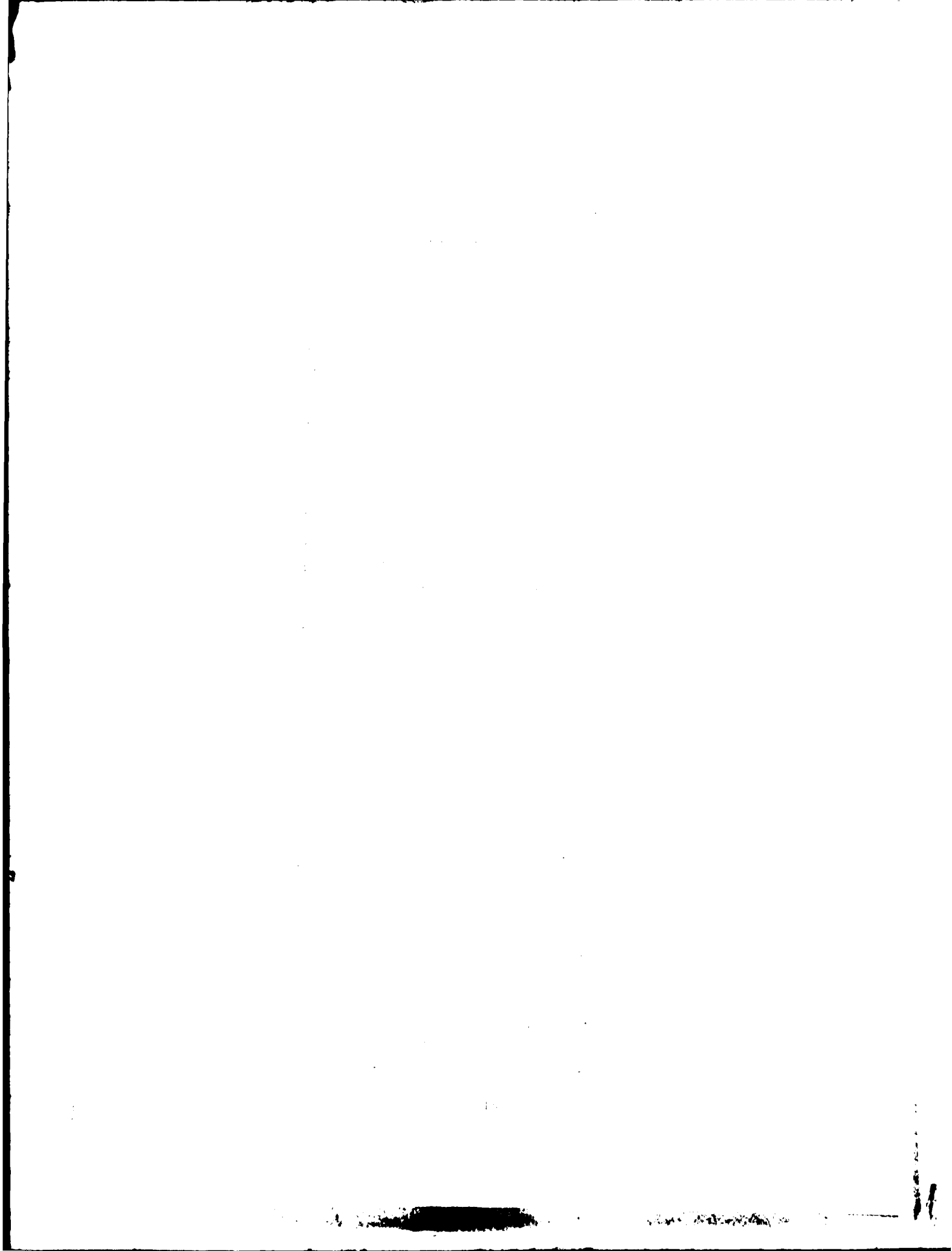




TABLE 10. — OZONE AND OXYGEN RESISTANCE TESTS OF POLYMER FORMULATIONS

Formulation	Preparation	Expected Damage	Time to Damage
NAVJAG-1*	Unoxidized Nitrite	Shallow, white, open cracks, surface flaking	Days
NAVJAG-2*	Unoxidized EPDM Natural Rubber Blend	None	100**
NAVJAG-3*	Unoxidized PVC	Cracks, surface flaking	100
NAVJAG-4*	Unoxidized EPDM Natural Rubber Blend	Cracks, surface flaking	100
NAVJAG-5*	Unoxidized Polyethylene	Cracking, probably surface	100
NAVJAG-6*	Unoxidized Polyethylene	None	100**
NAVJAG-7*	Unoxidized Polyethylene	Cracks, surface flaking	100

The natural rubber-butadiene blend control film that was subjected to compression molding at 170°C with mold temperature at 100°C was also subjected to the study. In addition, following the alkyl-alkyl polymer formalations, the poly(*n*-butyl acrylate)-poly(*n*-octyl acrylate) and poly(*n*-butyl acrylate)-poly(*n*-decyl acrylate) copolymers, with *n*-butyl acrylate as the monomer of the first monomer, were also prepared. These polymers exhibited various degrees of crystallinity. The changes were expected for these polymers and are consistent with the degree of swelling which was measured. At the same time, little change was expected for the copolymerized with the *n*-butyl acrylate and the chlorinated polyethylenes (HATPs) and also for the copolymerized with the chlorinated polyethylenes and butadiene, where the chlorinated polyethylene is a crystalline substance and resistant to the fluid when compared to the results for the other three polyurethane formalations.

The extreme and outdoor weathering resistance of the natural rubber-butadiene blend polymer was poor (Table 10), and all the other polymers and polymer blends exhibited better resistance than did the control. The propylene oxide-BAT-411, the

of the polymerization of BVA in the presence of the various catalysts and the effect of the concentration of the catalyst on the rate of polymerization. The results of these experiments are shown in Table I. It is seen that the rate of polymerization increases with increasing concentration of the catalyst. The rate of polymerization is also affected by the nature of the catalyst. The rate of polymerization is highest when the catalyst is  $\text{BF}_3 \cdot \text{OEt}_2$  and lowest when the catalyst is  $\text{AlEt}_3$ . The rate of polymerization is also affected by the nature of the monomer. The rate of polymerization is highest when the monomer is BVA and lowest when the monomer is  $\text{CH}_2=\text{CH}_2$ . The rate of polymerization is also affected by the nature of the solvent. The rate of polymerization is highest when the solvent is  $\text{CH}_2\text{Cl}_2$  and lowest when the solvent is  $\text{CH}_3\text{OH}$ .

The effect of the concentration of the catalyst on the rate of polymerization was also studied. The results of these experiments are shown in Table II. It is seen that the rate of polymerization increases with increasing concentration of the catalyst. The rate of polymerization is also affected by the nature of the catalyst. The rate of polymerization is highest when the catalyst is  $\text{BF}_3 \cdot \text{OEt}_2$  and lowest when the catalyst is  $\text{AlEt}_3$ . The rate of polymerization is also affected by the nature of the monomer. The rate of polymerization is highest when the monomer is BVA and lowest when the monomer is  $\text{CH}_2=\text{CH}_2$ . The rate of polymerization is also affected by the nature of the solvent. The rate of polymerization is highest when the solvent is  $\text{CH}_2\text{Cl}_2$  and lowest when the solvent is  $\text{CH}_3\text{OH}$ .

The effect of the nature of the catalyst on the rate of polymerization was also studied. The results of these experiments are shown in Table III. It is seen that the rate of polymerization is highest when the catalyst is  $\text{BF}_3 \cdot \text{OEt}_2$  and lowest when the catalyst is  $\text{AlEt}_3$ . The rate of polymerization is also affected by the nature of the monomer. The rate of polymerization is highest when the monomer is BVA and lowest when the monomer is  $\text{CH}_2=\text{CH}_2$ . The rate of polymerization is also affected by the nature of the solvent. The rate of polymerization is highest when the solvent is  $\text{CH}_2\text{Cl}_2$  and lowest when the solvent is  $\text{CH}_3\text{OH}$ .

The effect of the nature of the monomer on the rate of polymerization was also studied. The results of these experiments are shown in Table IV. It is seen that the rate of polymerization is highest when the monomer is BVA and lowest when the monomer is  $\text{CH}_2=\text{CH}_2$ . The rate of polymerization is also affected by the nature of the catalyst. The rate of polymerization is highest when the catalyst is  $\text{BF}_3 \cdot \text{OEt}_2$  and lowest when the catalyst is  $\text{AlEt}_3$ . The rate of polymerization is also affected by the nature of the solvent. The rate of polymerization is highest when the solvent is  $\text{CH}_2\text{Cl}_2$  and lowest when the solvent is  $\text{CH}_3\text{OH}$ .

REPORT OF HANSEN ON THE RESULTS OF THE  
EXPERIMENTAL INVESTIGATION OF THE  
EFFECTS OF THE MALARIAL PARASITE

The following is a summary of the results of the experiment conducted by Hansen on the effects of the malarial parasite. The experiment was conducted in the laboratory of the U. S. Army Medical Department, and the results were published in the U. S. Army Medical Department Report, No. 1, 1911.

The results of the experiment show that the malarial parasite, when introduced into the blood of a human being, causes a fever and other symptoms characteristic of malaria. The parasite was introduced into the blood of a human being by the use of a needle and syringe, and the results were observed for a period of several days. The results show that the parasite was able to multiply in the blood and cause the characteristic symptoms of malaria.

The results of the experiment also show that the malarial parasite is able to survive in the blood for a period of several days. This is in accordance with the results of other experiments conducted by other investigators. The results of the experiment also show that the malarial parasite is able to cause a fever and other symptoms characteristic of malaria.



Polymer Designation	Fabric Test Direction	Test Temperature (°C) (°F)	Ultimate Tensile Strength psi	Ultimate Elongation %	Tear Strength lb.	Coating** Adhesion lbs/in.
NR 50-50	Warp	29 (120)	1060	18	550	—
		24 (75)	1090	13	470***	—
		1 (32)	960	18	19	—
	Fill	29 (120)	840	26	55	—
		24 (75)	800	27	50	—
		1 (32)	860	19	190	—
NR 40-60	Warp	29 (120)	1550	17	100*	—
		24 (75)	1900	29	14	—
		1 (32)	90	32	24	—
	Fill	29 (120)	103	28	7	—
		24 (75)	106	17	50	—
		1 (32)	107	25	110	—
NR 30-70	Warp	29 (120)	150	4	27	—
		24 (75)	155	4	30*	—
		1 (32)	114	6	54*	—
	Fill	29 (120)	180	39	42*	—
		24 (75)	176	26	50*	—
		1 (32)	114	5	56*	—
NR 20-80	Warp	29 (120)	Polymer cover was sheared from fabric**			—
		24 (75)	114	4	500	—
		1 (32)	Test not performed			40***
	Fill	29 (120)	114	29	—	—
		24 (75)	12	3	63	—
		1 (32)	Test not performed			48***
NR 10-90	Warp	29 (120)	15	3	—	—
		24 (75)	117	3	44	34
	Fill	29 (120)	96	25	60*	—
		24 (75)	110	25	44*	—
NR 5-95	Warp	29 (120)	1080	3	—	—
		24 (75)	1190	3	14*	—
	Fill	29 (120)	1070	29	—	—
		24 (75)	115	27	13*	—

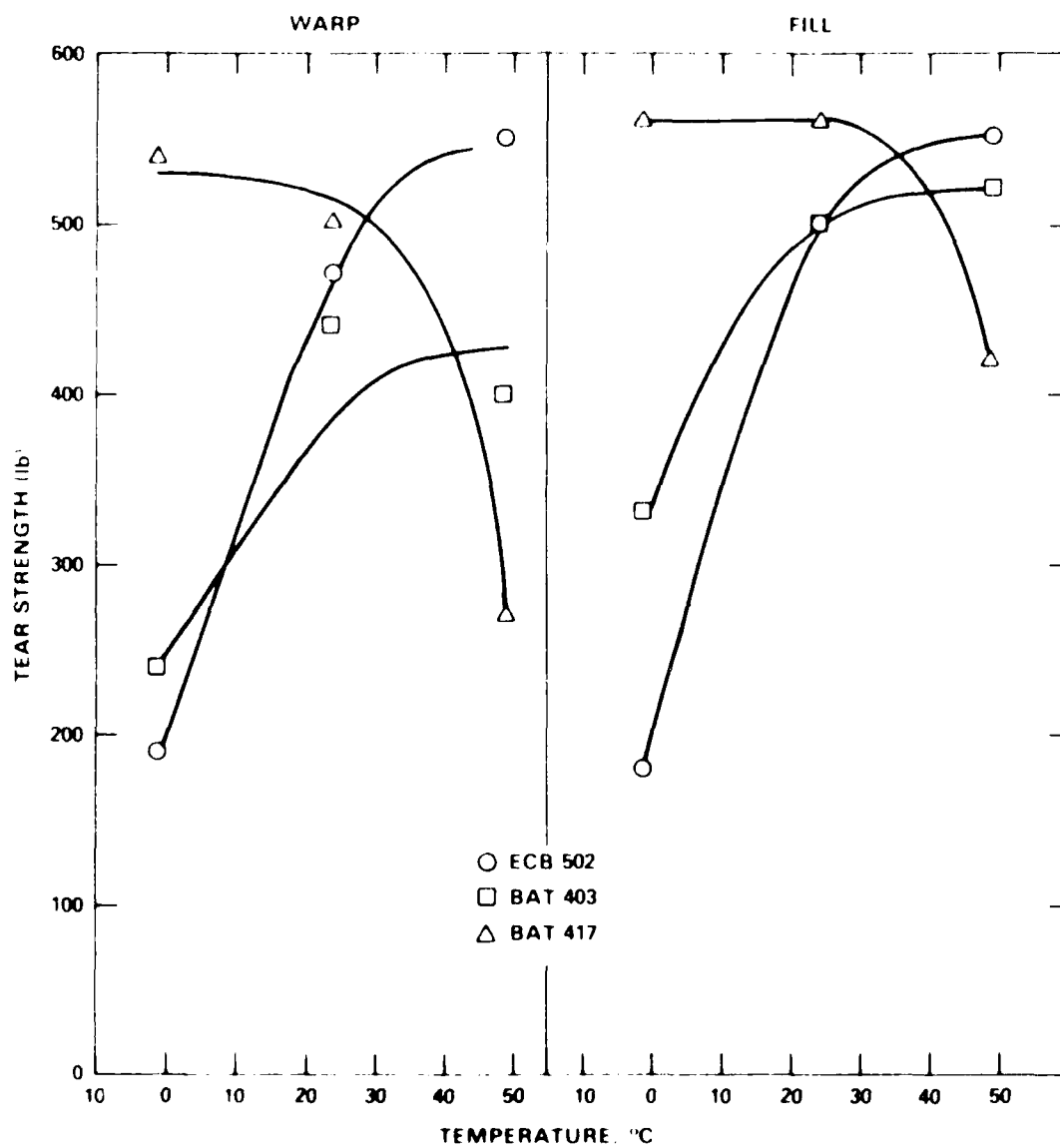
\*The nylon woven fabric was a 10 x 1 basket weave of 21 oz/yd<sup>2</sup> obtained from Fabric Development Laboratory, Inkertown, PA, with their designation 188.

\*\*The coat 408-91 was used to bond the gum rubber polymers to the fabric, and Flame 180 was used as an adhesion promoter with the polyurethane polymers.

\*\*\*Nylon cord partially pulled through the rubber and partially broke.

\*Nylon cord pulled through the rubber and did not break.

\*\*The Neoprene rubber 10 coat retarded the cure of the chlorinated polyethylene at the interface so that the chlorinated polyethylene remained a thermoplastic at the interface which softens markedly between 40° (109°F) and 49° (120°F).









1. The first part of the report discusses the general situation of the country and the progress of the work during the year. It also mentions the results of the various investigations and the conclusions drawn from them.

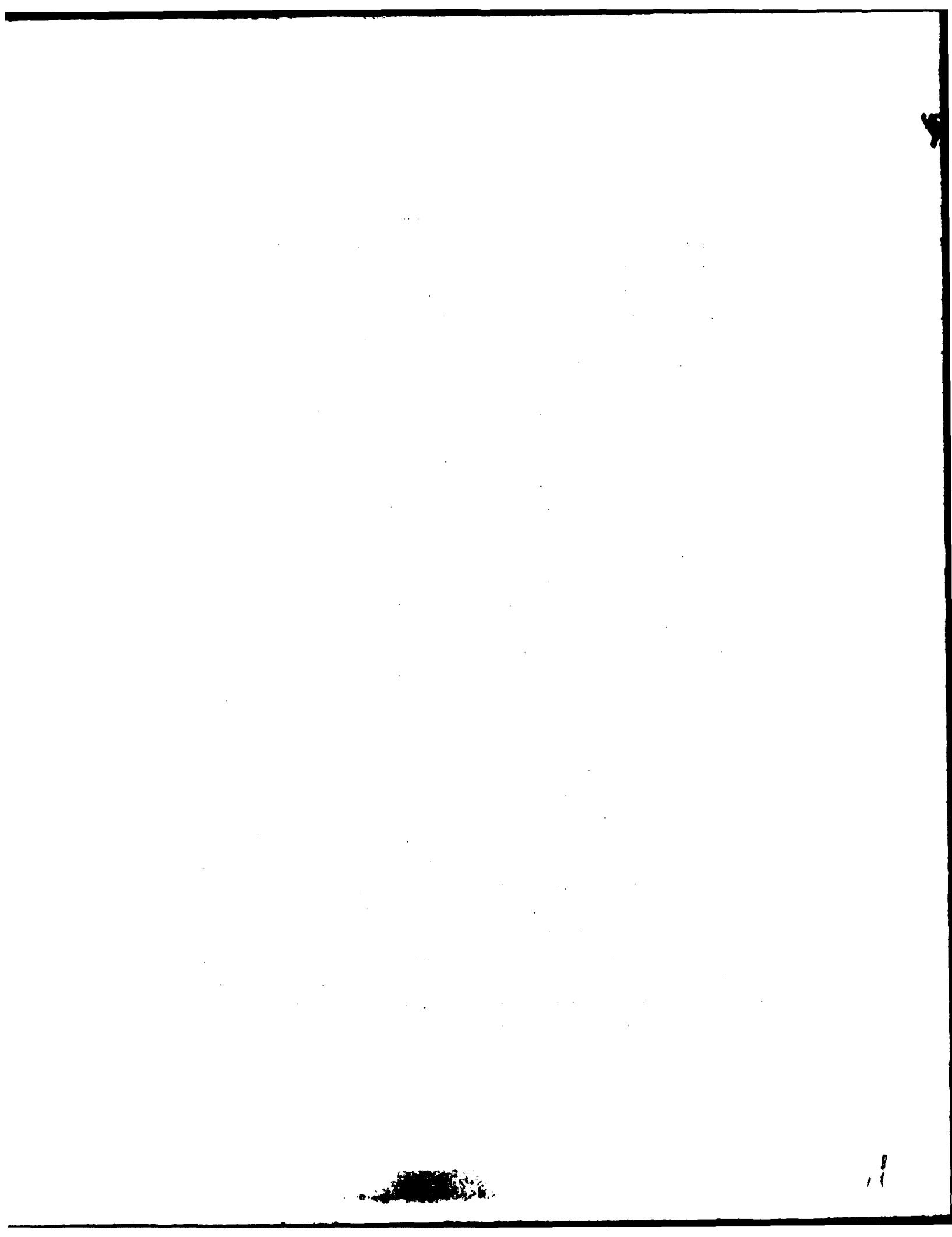
2. The second part of the report deals with the specific details of the work, including the methods used, the results obtained, and the conclusions reached. It also mentions the various difficulties encountered and the ways in which they were overcome.

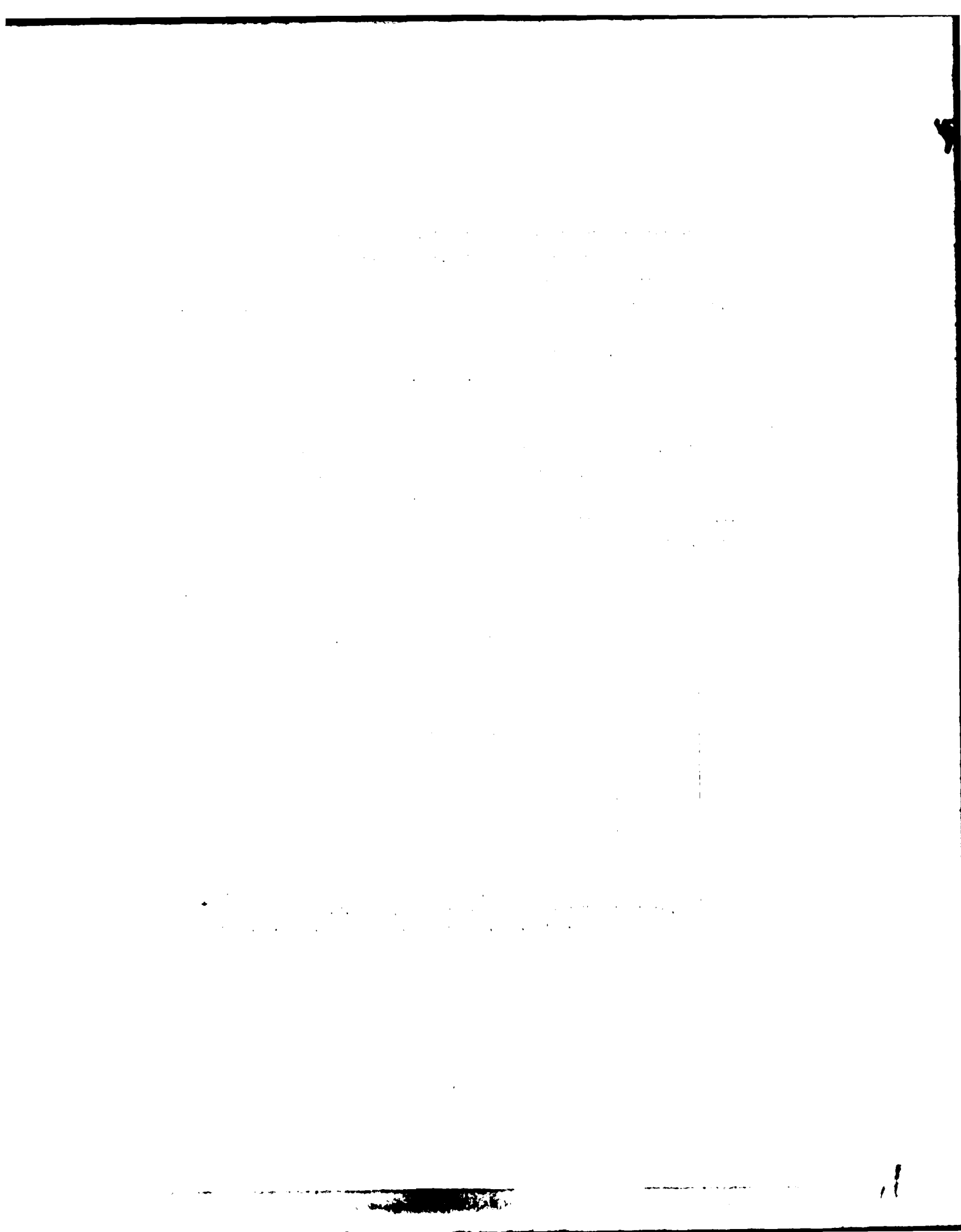
3. The third part of the report discusses the future work and the plans for the coming year. It also mentions the various resources available and the ways in which they will be used.

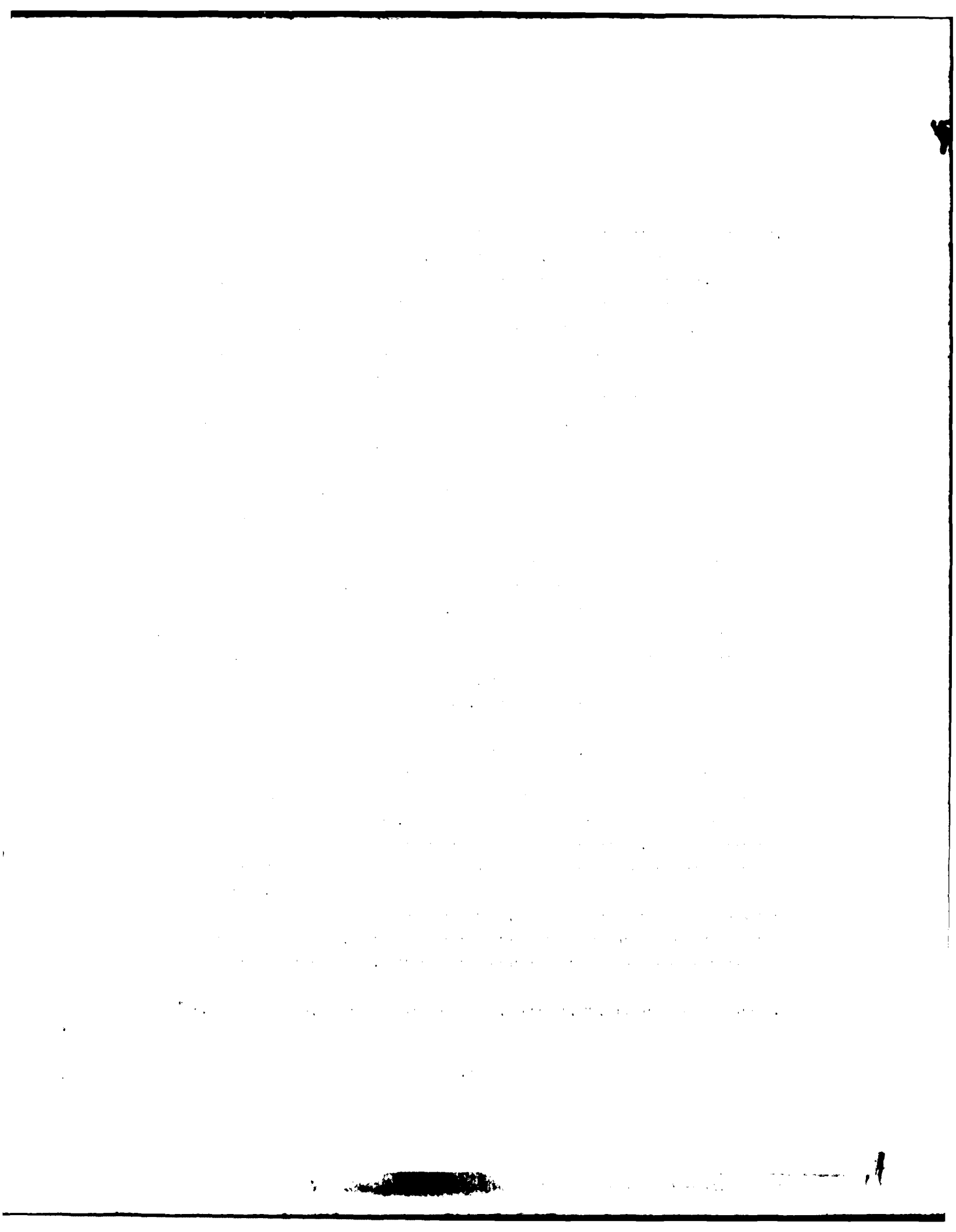
4. The fourth part of the report discusses the various contributions made by the different members of the team and the ways in which they have helped to advance the work.

5. The fifth part of the report discusses the various publications and reports that have been produced during the year and the ways in which they have contributed to the advancement of the field.

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11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
31.	32.	33.	34.	35.	36.	37.	38.	39.	40.
41.	42.	43.	44.	45.	46.	47.	48.	49.	50.
51.	52.	53.	54.	55.	56.	57.	58.	59.	60.
61.	62.	63.	64.	65.	66.	67.	68.	69.	70.
71.	72.	73.	74.	75.	76.	77.	78.	79.	80.
81.	82.	83.	84.	85.	86.	87.	88.	89.	90.
91.	92.	93.	94.	95.	96.	97.	98.	99.	100.







[illegible]

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TABLE 1. ANALYTICAL DATA OF POLYMERIZATION OF MONOMER A

Run	Monomer A	Butyl By Weight
1	100.0	100.0
2	100.0	100.0
3	100.0	100.0
4	100.0	100.0
5	100.0	100.0
6	100.0	100.0
7	100.0	100.0
8	100.0	100.0
9	100.0	100.0
10	100.0	100.0
11	100.0	100.0
12	100.0	100.0
13	100.0	100.0
14	100.0	100.0
15	100.0	100.0
16	100.0	100.0
17	100.0	100.0
18	100.0	100.0
19	100.0	100.0
20	100.0	100.0
21	100.0	100.0
22	100.0	100.0
23	100.0	100.0
24	100.0	100.0
25	100.0	100.0
26	100.0	100.0
27	100.0	100.0
28	100.0	100.0
29	100.0	100.0
30	100.0	100.0
31	100.0	100.0
32	100.0	100.0
33	100.0	100.0
34	100.0	100.0
35	100.0	100.0
36	100.0	100.0
37	100.0	100.0
38	100.0	100.0
39	100.0	100.0
40	100.0	100.0
41	100.0	100.0
42	100.0	100.0
43	100.0	100.0
44	100.0	100.0
45	100.0	100.0
46	100.0	100.0
47	100.0	100.0
48	100.0	100.0
49	100.0	100.0
50	100.0	100.0
51	100.0	100.0
52	100.0	100.0
53	100.0	100.0
54	100.0	100.0
55	100.0	100.0
56	100.0	100.0
57	100.0	100.0
58	100.0	100.0
59	100.0	100.0
60	100.0	100.0
61	100.0	100.0
62	100.0	100.0
63	100.0	100.0
64	100.0	100.0
65	100.0	100.0
66	100.0	100.0
67	100.0	100.0
68	100.0	100.0
69	100.0	100.0
70	100.0	100.0
71	100.0	100.0
72	100.0	100.0
73	100.0	100.0
74	100.0	100.0
75	100.0	100.0
76	100.0	100.0
77	100.0	100.0
78	100.0	100.0
79	100.0	100.0
80	100.0	100.0
81	100.0	100.0
82	100.0	100.0
83	100.0	100.0
84	100.0	100.0
85	100.0	100.0
86	100.0	100.0
87	100.0	100.0
88	100.0	100.0
89	100.0	100.0
90	100.0	100.0
91	100.0	100.0
92	100.0	100.0
93	100.0	100.0
94	100.0	100.0
95	100.0	100.0
96	100.0	100.0
97	100.0	100.0
98	100.0	100.0
99	100.0	100.0
100	100.0	100.0

# ANNEX A. CONTENTS OF CONTRACT FORMULATION (CGB-002)

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99. Conclusion	99
100. Acknowledgments	100





APPENDIX A  
SELECTION OF GUM RUBBER POLYMERS

1. INTRODUCTION

The control polymer formulation developed for the coatings on woven fabric surfaces was based on the formation of a film of a polymer or polymer blends. The polymer or polymer blends were formulated with the consideration of the cost and the properties of the polymers which are required for the coatings polymers. The polymers were formulated with one half of the polymer or polymer blends to obtain a mixture of the polymer and the other half of the polymer or polymer blends. The polymers, in the form of a mixture, were then formulated into a mixture of the polymer and the other half of the polymer or polymer blends. This was investigated with the use of the following:

The polymers, in the form of a mixture, were formulated and compared to a control polymer or polymer blend polymer which was a government furnished reference polymer. The polymers, in the form of a mixture, were formulated and compared to a control polymer or polymer blend polymer which was a government furnished reference polymer. The contents of this formulation are shown in Table A-1. A mixture of the polymers in the form of a mixture and the other half of the polymer or polymer blends was evaluated to date for the use of the polymers in the form of a mixture and the other half of the polymer or polymer blends. The polymers, in the form of a mixture, were evaluated with initial screening tests and the results compared to the results of the control polymer or polymer blend polymer. The three best formulations were selected and evaluated further with the results compared to the results of the control polymer or polymer blend polymer. The three best formulations were selected, and together with the control formulation, used as a mixture of the polymers in the form of a mixture and the other half of the polymer or polymer blends. The coated fabrics were characterized with property tests which are shown in Appendix C.

(c) Polymers reinforced with knit and mat structures do not exhibit as good resistance to strength as polymers reinforced with woven fabric for the same weight reinforcement.

(d) A crystalline polyethylene was developed which had relatively good resistance to aging, but not to weathering, but the chemical nature and mechanical properties were relatively poor.

(e) A crystalline polyethylene polymer formed from polybutadiene/styrene copolymers had excellent mechanical properties, but the compressive strength was poor at elevated temperature rise caused by hysteresis in the polymer.

(f) A crystalline polyethylene polymer of suitable density, density and mechanical properties was developed for the production of sheets of suitable size for use in the Apollo program.

1. The control fabric, styrlite, the formulated EPDM natural rubber blend, and the formulated copolymer blend (butadiene-styrene copolymer) all exhibited properties equivalent to the natural butadiene blend control. 2. The control fabric, styrlite, exhibited outstanding resistance to fuel. 3. The control fabric, styrlite, exhibited good resistance to fuel. 4. The control fabric, styrlite, exhibited good resistance to fuel.

5. The control fabric, styrlite, exhibited good resistance to fuel. 6. The control fabric, styrlite, exhibited good resistance to fuel. 7. The control fabric, styrlite, exhibited good resistance to fuel. 8. The control fabric, styrlite, exhibited good resistance to fuel. 9. The control fabric, styrlite, exhibited good resistance to fuel. 10. The control fabric, styrlite, exhibited good resistance to fuel.

11. The control fabric, styrlite, exhibited good resistance to fuel. 12. The control fabric, styrlite, exhibited good resistance to fuel. 13. The control fabric, styrlite, exhibited good resistance to fuel. 14. The control fabric, styrlite, exhibited good resistance to fuel. 15. The control fabric, styrlite, exhibited good resistance to fuel.

16. The control fabric, styrlite, exhibited good resistance to fuel. 17. The control fabric, styrlite, exhibited good resistance to fuel. 18. The control fabric, styrlite, exhibited good resistance to fuel. 19. The control fabric, styrlite, exhibited good resistance to fuel. 20. The control fabric, styrlite, exhibited good resistance to fuel.

21. The control fabric, styrlite, exhibited good resistance to fuel. 22. The control fabric, styrlite, exhibited good resistance to fuel. 23. The control fabric, styrlite, exhibited good resistance to fuel. 24. The control fabric, styrlite, exhibited good resistance to fuel. 25. The control fabric, styrlite, exhibited good resistance to fuel.

26. The control fabric, styrlite, exhibited good resistance to fuel. 27. The control fabric, styrlite, exhibited good resistance to fuel. 28. The control fabric, styrlite, exhibited good resistance to fuel. 29. The control fabric, styrlite, exhibited good resistance to fuel. 30. The control fabric, styrlite, exhibited good resistance to fuel.

31. The control fabric, styrlite, exhibited good resistance to fuel. 32. The control fabric, styrlite, exhibited good resistance to fuel. 33. The control fabric, styrlite, exhibited good resistance to fuel. 34. The control fabric, styrlite, exhibited good resistance to fuel. 35. The control fabric, styrlite, exhibited good resistance to fuel.

## CONCLUSIONS

1. Results from laboratory tests at 50 psi on 20-gm rubber formulations prepared from 15 synthetic polymer or polymer blend systems indicated that: (a) two of the formulated polymer systems (carboxylated nitrile and chlorinated polyethylene) had crack growth resistance greater than that of the control polymer blend (natural rubber butadiene), and (b) six of the formulated polymer systems (carboxylated nitrile, trans butyl, natural rubber, EPDM blend, SB black copolymer, SBR blend, SB black copolymer, natural blend, and chlorinated polyethylene, phosphor tritric fluoroclastomer) had tear fatigue resistance greater than that of the control polymer blend.

2. Results from laboratory tests at 50 psi on a variety of liquid castable polyurethane polymer formulations prepared from five different polyalcohols, four different triisocyanates, and four diamine or diolcohol curatives indicated that: (a) polyurethane liquid polyurethane formulations had better crack growth resistance than the control polyurethane polymer (BALT-100), and (b) one formulation had better tear fatigue resistance than the control and one formulation had about the same tear fatigue resistance as the control.

3. Nylon woven fabric coated with the natural rubber butadiene blend control formulation exhibits a marked reduction in tear strength at -100°C. compared to tear strength at room temperature. Similar effects, but to lesser degrees, are exhibited by the transbutyl-EPDM/natural rubber blend coated woven fabric at -100°C. and the SB black copolymer/natural rubber blend coated woven fabric at 0°C. and -100°C. The reduction in strength appears to be caused by a modulus change of the polymer such that the polymer causes the fibers in the yarn bundles to pull apart. Thus, consequently, for complete characterization, polymer coated woven fabrics should be evaluated for mechanical properties over the range of temperatures anticipated for air cushion vehicle use.

4. Ketoblack 80 conductive carbon black appears to more effectively increase the thermal conductivity of polymers than regular retort type carbon blacks. Since ketoblack exhibits non-reinforcing in most polymers, a detailed study is necessary in conjunction with retorting carbon blacks to determine if optimum mechanical and thermal properties can be obtained concurrently with improved thermal conductivity.

5. Based on the Pico laboratory abrasion test, the SB black copolymer/natural rubber polymer blend had superior abrasion resistance compared to the natural rubber butadiene blend control polymer, and one castable liquid polyurethane polymer exhibited better abrasion resistance than the control.

[illegible]

<sup>a</sup> The number of subjects who were included in each group was 10.

[illegible]

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knit, strike zone, are presented in Table 17. The materials are prepared by the knit factory, which features a lock stitch that prevents raveling. The polyester was selected for use in this program since it possesses strength approaching that of rayon in both warp and fill directions but at a fabric weight of only 14.7 g/m<sup>2</sup> compared to the 20.4 g/m<sup>2</sup> of rayon. The manufacturer advised that the mechanical properties of this polyester are good, or better than, that of the rayon.

Knit rayon and polyester reinforced PI-co polymer were coated with formulation 1000, and the results are set out in the unrelaxed formulation. It was also cast, and the results for the knit material show that the unexpected cure properties of formulation 1000 with this material as well as the overcured gel formed by postcure are not observed with the three-layer tensile strength than did immediate curing (see Table 18, Appendix B).

TABLE 17. PROPERTIES OF KNIT RAYON AND POLYESTER KNITS

Material	Density	Weight g/m <sup>2</sup>	Tensile Strength, lb		Wet Burst lb
			PII		
			Warp	Fill	
Rayon	1.54	20.4	136	134	600
Polyester	1.38	14.7	109	152	500

The polyester reinforced PI-co polymer was tested at three temperatures, and the tensile strength, tear strength and coating adhesion results are presented in Table 18, and the knit fabric results are presented in Table 19. Since the reinforcement terms are the tensile and tear strength of reinforced polymers, the results are compared to the results obtained on woven fabric reinforced PI-co (Table 18). As compared to the results shows that the knit reinforced PI-co has a tensile strength approximately equal to the tear strength of the woven fabric reinforced PI-co, approximately the same reinforcement weight. However, the elongation at break is approximately three times greater than the woven fabric reinforced material, while the coating adhesion value for the knit material appears to be only one-quarter of the polyester knit. These large areas of strike may indicate that the test in this case is measuring cohesive strength of the polymer reinforcement rather than the force required to peel the elastomer from the knit. A knit reinforcement structure does not yield as efficient a reinforcement as a woven fabric on a strength-to-weight basis.



1. NAME  
 2. ADDRESS  
 3. CITY  
 4. STATE  
 5. ZIP  
 6. PHONE  
 7. TELETYPE  
 8. FAX  
 9. EMAIL  
 10. DATE  
 11. TIME  
 12. BY  
 13. FOR  
 14. REMARKS  
 15. INITIALS  
 16. SIGNATURE  
 17. DATE  
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 22. INITIALS  
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 42. REMARKS  
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 44. SIGNATURE  
 45. DATE  
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 129. DATE  
 130. TIME  
 131. BY  
 132. FOR  
 133. REMARKS  
 134. INITIALS  
 135. SIGNATURE  
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The gel permeation method was evaluated for sensitivity to cure pressure using autoclave cure at 1 bar, gel and glass transition at 300°C and 250°C; no sensitivity to cure pressure was found.



TABLE A.6 - BROMOBUTYL RUBBER FORMULATIONS\*

Ingredients	Formula Designation		
	BAL 403	BAL 404	BAT 405
Bromobutyl, %	60	60	100
Resulfone, %	10	5	—
SPB, %	—	25	—
Elastomer 1, % polybutadiene	—	10	—
Nonyl-phenol	2	—	25
Nonyl-phenol	—	10	—
Hydrocarbon	—	10	25
Nonyl-phenol	5	—	—
Hydrocarbon	—	5	—
Nonyl-phenol	—	—	2
Hydrocarbon	—	—	2
Hydrocarbon	—	10	—
Hydrocarbon	1	1	25
Hydrocarbon	0	4	—
Hydrocarbon	—	1.75	1.75
Hydrocarbon	1.75	1.75	1.75
Hydrocarbon	1.75	—	—
Hydrocarbon	—	2.5	2.5

\*All ingredients are in parts by weight.

SPB is a polybutadiene copolymer of BAL 403, SBC-48, 101 and 102, and is used in BAL 404.

THE UNIVERSITY OF CHICAGO  
DIVISION OF THE PHYSICAL SCIENCES  
DEPARTMENT OF CHEMISTRY

RECEIVED  
JAN 10 1964  
FROM  
J. H. DUNN

1. The following is a list of the  
names of the persons who have  
been associated with the  
Department of Chemistry  
since the year 1900.

2. The names are arranged in  
alphabetical order of the  
last name, and the first  
name is given in full.  
The year of birth is given  
in parentheses after the  
name.

3. The names of the persons  
who have been associated  
with the Department of  
Chemistry since the year  
1900 are given in full.

TABLE V. BUTYL RUBBER FORMULATIONS

Ingredient	Formula designation		
	BAT-41	BAT-41A	BAT-41B
Neoprene W	100	100	100
Cl-4-12-3	1	1	1
N-33	1	1	1
N-35	1	1	1
Cl-4-12-3-011	1	1	1
Diethyl sebacate	1	1	1
Phenyl Ac-11	1	1	1
Azobisisobutyronitrile	1	1	1
Altax	1	1	1
Dieneex	1	1	1
Sulfur	1	1	1

\* Phillips Chemical Co., Stowe, OH.  
Phillips Chemical designation is  
DCD-1257.



TABLE A. Summary of the results of the analysis of variance for the effect of the treatment on the response of the subjects.

Source of variation	df	Sum of squares	Mean square	F	Prob
Between groups	1	1.25	1.25	1.25	.27
Within groups	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
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Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			
Error	10	1.25	.125		
Total	11	2.50			

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 1, 1861. It is a very important document, as it sets out the policy of the new administration. The President states that he is committed to the principles of liberty and justice for all, and that he will work to maintain the Union. He also mentions the issue of slavery, which was a major point of contention at the time.

2. The second part of the document is a report from the Secretary of the Treasury, dated January 1, 1861. It provides a detailed account of the financial state of the country. The report mentions the national debt, which had increased significantly since the end of the Civil War. It also discusses the various sources of revenue, including taxes and customs duties.

3. The third part of the document is a report from the Secretary of the Interior, dated January 1, 1861. It provides a detailed account of the land and natural resources of the country. The report mentions the various territories and states, and the progress of settlement. It also discusses the various industries, including agriculture and mining.

4. The fourth part of the document is a report from the Secretary of the Navy, dated January 1, 1861. It provides a detailed account of the naval forces of the country. The report mentions the various ships and vessels, and the progress of the fleet. It also discusses the various operations, including the protection of commerce and the maintenance of peace.

5. The fifth part of the document is a report from the Secretary of the War, dated January 1, 1861. It provides a detailed account of the military forces of the country. The report mentions the various regiments and brigades, and the progress of the army. It also discusses the various operations, including the defense of the country and the maintenance of order.

UNITED STATES DEPARTMENT OF AGRICULTURE

Report of the  
Bureau of Plant Industry  
on the  
Work of the Bureau of Plant Industry  
for the Year 1917

Washington, D. C.  
1918

Published by the  
Government Printing Office

For sale by the  
Government Printing Office  
Washington, D. C.  
Price, 10 cents

The Bureau of Plant Industry, United States Department of Agriculture, was organized in 1904, and since that time has been engaged in a wide range of research and practical work. The work of the Bureau is divided into several branches, each of which is headed by a Chief of Branch. The branches are: (1) the Branch of Plant Pathology, (2) the Branch of Plant Breeding, (3) the Branch of Plant Physiology, (4) the Branch of Plant Geography, (5) the Branch of Plant Quarantine, (6) the Branch of Plant Conservation, (7) the Branch of Plant Industry, and (8) the Branch of Plant Education. The work of the Bureau is carried on in the following manner: (1) the Branch of Plant Pathology, (2) the Branch of Plant Breeding, (3) the Branch of Plant Physiology, (4) the Branch of Plant Geography, (5) the Branch of Plant Quarantine, (6) the Branch of Plant Conservation, (7) the Branch of Plant Industry, and (8) the Branch of Plant Education.





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# Calculation of Curative weight

The following equations may be used to calculate the curative addition required:

CL = curative level per 100 parts prepolymer

Percent NCO, Equivalent Wt. Curative x Curative Mole Ratio

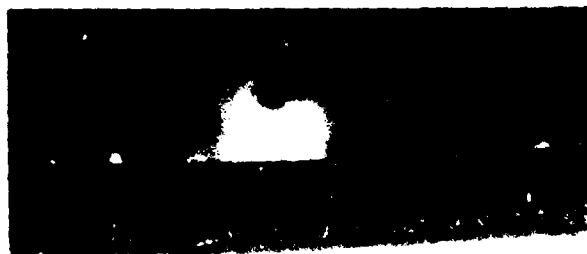
Curative Mole Ratio =  $\frac{\text{Theoretical Curative Level}}{100}$

## TABLE I. - TENSILE STRENGTH OF NILON AND POLYESTER MAT

Temp. No.	Material	Weight oz./sq. ft.	Tensile Strength, P.S.I.
60°C.	Nylon MAT	1.0	100
100°C.	Polyester MAT	1.0	100



Figure 1. Polyurethane Formulation 146, 11.8 oz/yd<sup>2</sup> (50% infiltrated) and 14.5 oz/yd<sup>2</sup> (50% infiltrated) Polyurethane Formulation 146.



b) POLYURETHANE  
FORMULATION 146

COMPLETELY  
INFILTRATED MAT.  
5.5 oz/yd<sup>2</sup>

b) POLYURETHANE  
FORMULATION 146

95-100% INFILTRATED MAT  
11.8 oz/yd<sup>2</sup>

c) POLYURETHANE  
FORMULATION 146

INFILTRATED MAT (50-60%)  
UNINFILTRATED MAT (40-50%)  
14.5 oz/yd<sup>2</sup>

Figure B-1 - Permeation of Formulation 205 Polyurethane Into Polyester Mats  
of Weight 5.5, 11.8 and 14.5 Ounces per Square Yard



a) CAST  
LIQUID 205  
IMPREGNATED  
MAT.

5.5 oz/yd<sup>2</sup>



b) CAST LIQUID  
FORMULATION 205  
IMPREGNATED MAT.  
UNIMPREGNATED MAT.

11.8 oz/yd<sup>2</sup>



c) CAST LIQUID  
FORMULATION 205  
IMPREGNATED MAT.  
UNIMPREGNATED MAT.

14.5 oz/yd<sup>2</sup>



2.2.2. The first 10 ml of the sample is added to a beaker and treated with a side of 10 ml of 0.1N NaOH solution. The second 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The third 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The fourth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The fifth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The sixth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The seventh 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The eighth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The ninth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The tenth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution.

2.2.3. The first 10 ml of the sample is added to a beaker and treated with a side of 10 ml of 0.1N NaOH solution. The second 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The third 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The fourth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The fifth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The sixth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The seventh 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The eighth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The ninth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The tenth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution.

#### 2.2.4. Calculation of % NaOH

The percentage of NaOH content is defined as the percent by weight of NaOH in the sample. It is determined by the following calculation:

1. The first 10 ml of the sample is added to a beaker and treated with a side of 10 ml of 0.1N NaOH solution. The second 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The third 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The fourth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The fifth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The sixth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The seventh 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The eighth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The ninth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution. The tenth 10 ml of the sample is added to the beaker and treated with a side of 10 ml of 0.1N NaOH solution.

2. The percentage of NaOH content is then determined using the following calculation:

$$\text{Percent NaOH} = \frac{(\text{Volume of NaOH} \times \text{Normality of NaOH})}{\text{Weight of Sample (g)}}$$

- 1. Volume of 0.1N NaOH required for blank (ml)
- 2. Volume of 0.1N NaOH required for sample (ml)
- 3. Normality of NaOH solution

**Bromophenol Blue Indicator:** Dissolve 0.1 g dry bromophenol blue in 1.5 ml 0.1N NaOH and dilute to 100 ml with distilled water.

Field No.	Date	Locality	Collector	Plant	Height	Fls.	Fruit	Notes
1001	10/1/54	...	...	...	...	...	...	...
1002	10/1/54	...	...	...	...	...	...	...
1003	10/1/54	...	...	...	...	...	...	...
1004	10/1/54	...	...	...	...	...	...	...
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...the filter was placed in a desiccator with a few drops of water to prevent drying. The filter was then placed in a desiccator with a few drops of water to prevent drying. The filter was then placed in a desiccator with a few drops of water to prevent drying.

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- 1.4.5 oz. vol. mat. = approximately 50% permeation
- 1.8.5 oz. vol. mat. = approximately 60% permeation
- 2.5 oz. vol. mat. = approximately 90% permeation.

## TASK 2 - HOMOGENEOUS MATERIALS DEVELOPMENT

In order to prepare specimens for evaluation in this task, the handling procedures for the polyurethane polymers had to be modified. The addition of 5% carbon black or 5% fumed silica increased the viscosity of the prepolymers to such an extent that the additives could not be added either by simple stirring or in a paint mill.

For formulation PU-208 (BAT-140 + 5% carbon black + 5% fumed silica), approximately 1% of xylene was added to reduce the viscosity, and a satisfactory dispersion was obtained by milling on a paint mill. This material was then stirred with a high-speed, low-speed stirrer under vacuum to remove the solvent. Analysis of the prepolymer indicated a 2.95% isocyanate content (compared to 3.4% normally expected for this material). The lower NCO figure may have been due to reaction of the isocyanate group with atmospheric moisture, since a large surface area of the prepolymer is exposed during milling. The correct calculated quantity of curative was subsequently formulated into the prepolymer and the material was successfully cast into a 1- $\text{cm}^2$  sheet.

For PU-211 (PU-208 + 5% carbon black) a slightly different approach was adopted in the modification procedure. The modification was to incorporate the 5% carbon black into the polyurethane prepolymer and, separately, blend the 5% fumed silica into the butane diol chain extender. The two modified components were then to be mixed in a "Newfit" cartridge dispenser, and extruded followed by molding in dies to form 1- $\text{cm}^2$  sheets.

The carbon black was successfully incorporated into the prepolymer. However, blending the 5% into the butane diol was found to be impossible, since only a small quantity is necessary to satisfy the stoichiometric requirements of the prepolymer. (For a prepolymer of 3% NCO content, this would amount to about 0.3 g of butane diol per 10 g of prepolymer). Consequently, a compromise was made, and the material was cast containing the carbon black only.

For PU-212 (PU-198 + 5% carbon black and 5% silica) the addition of approximately 1% xylene was necessary, and curing of the polymer was considerably retarded by the presence of the solvent, even though this system was catalyzed with T-12 catalyst. Even post-cure of this material was delayed until most of the solvent had diffused out; otherwise voids would have been formed by the solvent vapor.

It is concluded from the above that it was necessary to cure this material during the polymerization to retain the properties which existed when the polymer was first prepared. The authors state that the results for the material allowed to cool slowly were better than those for material allowed to cool while continuing to react, which indicates that atmospheric moisture may also have had a detrimental effect. The material used in polymerization which cures slowly since it is not exempt of moisture, constitutes only the gelled polymer and react with free radicals, i.e., water, oxygen.

The full potential of this formulation can be obtained only when the material is heated immediately in a fused film.

formulations. Preliminary work, in addition to the formulation work performed at BAI, demonstrated that an additional system was indicated. This was an additional system of formulation of BAI latex, but substituting a PPM of 9000 for the 1000 PPM of polyisobutylene in the BAI latex. Other parameters such as NO of BAI and the amount of water used remained the same. The purpose of this investigation was to determine if the use of a higher molecular weight BAI latex with the lower molecular weight polyisobutylene would result in a better material of higher molecular weight than the original system.

The new system, consisting of latex, was experimentally evaluated for both screening and for the more detailed laboratory and field tests. A characterization test evaluation

was conducted on the coated woven fabrics.

For the laboratory and field testing, two polyurethane formulations, one of which was selected and used to prepare coated fabric samples.

The first experiment was described earlier for the vinyl rubber polymer work. The second experiment was conducted in order to find out if, for the same, the 1-5yd<sup>2</sup> sheets of fabric were coated three times in order to achieve a thickness of one mil. The sheets were coated three times in order to achieve a thickness of one mil. The fabric was then treated for 24 hours. A second coating was applied to the fabric and allowed to dry.

The second experiment of the fabric was coated with the liquid elastomer using a brush. The results of the experiment were at BAI demonstrated that, in order to achieve a thickness of one mil, the brush would be applied to the surface of the fabric and strike through at the fiber-to-fiber intersections, in spite of the texture and nature of the vinyl rubber. After gelling, the partially coated fabric sections were turned over and coated on the opposite side.

Finally, the coated sheets were post-cured at 100°C (212°F) for 4 hr.

The sheets, now, were prepared for testing at BAI, and for delivery to the center for evaluation. In addition to the coated fabric specimens, 1-5yd<sup>2</sup> sheets of the untreated elastomer were also prepared for delivery to the center.

In the case of polyurethane formulation 200, a difference in processing was necessary in the fabrication of large size (1-5yd<sup>2</sup>) sheets of the fabric reinforced material which were required. Whereas the properties of the original formulation were derived from test sheets prepared by heat curing of the liquid elastomer in 1-5yd<sup>2</sup> sheets immediately after casting, the polymers applied to the 1-5yd<sup>2</sup> sheets of fabric were allowed to gel overnight to facilitate handling; they were then oven-cured at 100°C (212°F) for 4 hr.



[illegible]

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PBD	Reaction of PBD with PBD							
	R <sub>1</sub> CM				CSLS			
	IPDI		H <sub>12</sub> MDI		IPDI		H <sub>12</sub> MDI	
Control Case	R <sub>1</sub> CM	MDA	R <sub>1</sub> CM	MDA	R <sub>1</sub> CM	MDA	R <sub>1</sub> CM	MDA
Estimated	190	191	187	186	19	189	186	184

In general, all four prepolymer, when treated with MDA as a curative, reacted slowly to form a viscous material similar to a cold, opaque, light brown rubbery materials at low dilutions. The short reaction times automatically eliminated these materials from further consideration.

When the prepolymer, when treated with BDO as a curative, reacted so slowly that it was necessary to catalyze the reaction with 0.12-1.0% catalyst. These materials were collected overnight and were then post-cured at 150°C for 24 hours. They were labeled as low modulus elastomers, 185, 187, 190, and 191 for reference to the results shown in Appendix C.

The work in this case was supplemented as follows: An additional cold, opaque elastomer, 188, was formulated at a higher NCO ratio of 3:1 to prepare a elastomer of higher modulus. Generally, these materials did not possess adequate thermal stability and/or rate of growth to be useful.

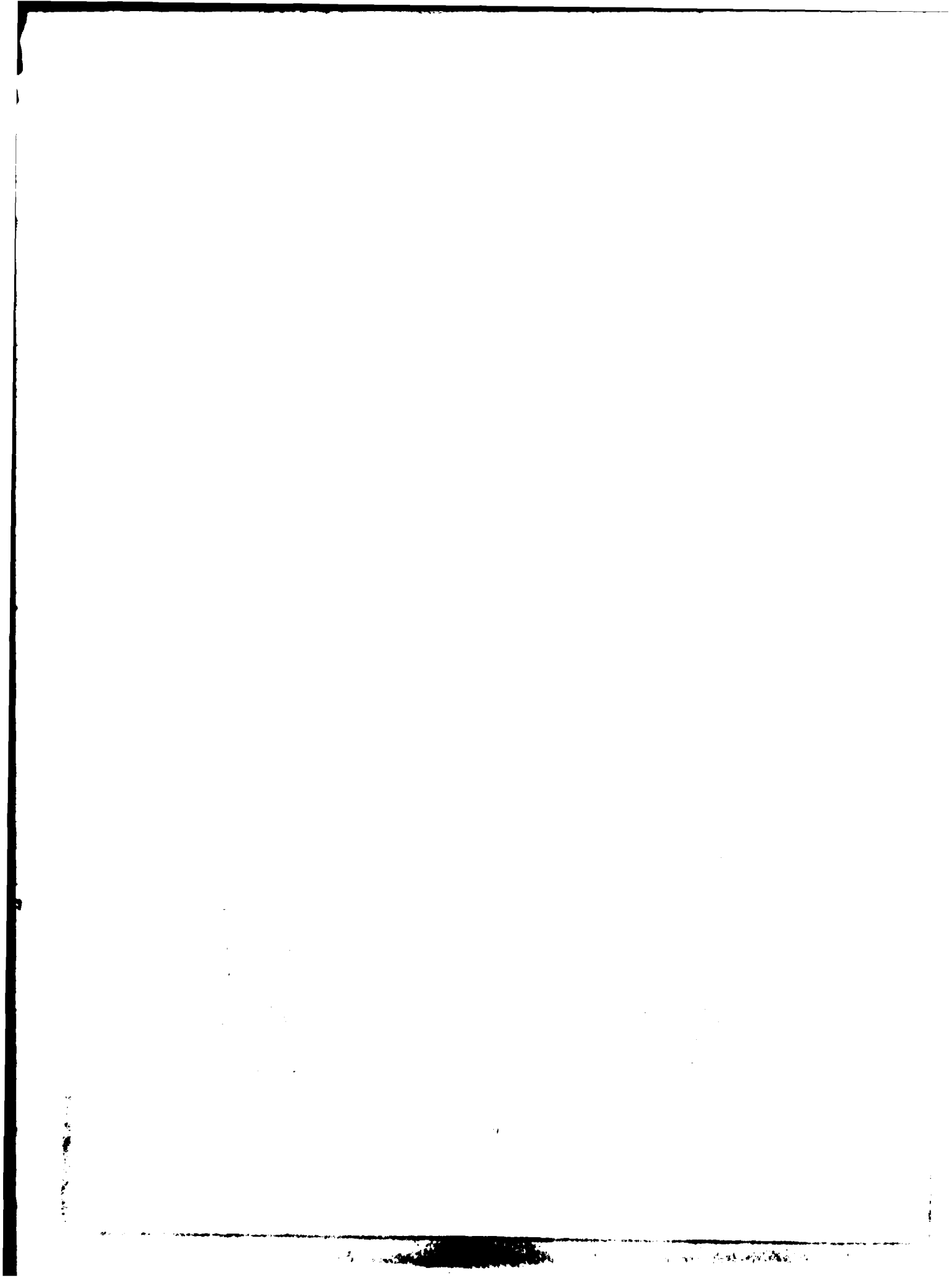
As was known with personnel at the center, it was agreed to further evaluate the prepolymer with various other and less curative agents, Isonol 1-3 (N, N-bis-2-ethyl-1,3-hexane diol) and ethyl 1:3 hexane diol with a potential yield of

1.0-1.5% (based on the prepolymer). The prepolymer was heated to 150°C and attempted heating, the prepolymer reacted slowly to form a nonpolymer R<sub>1</sub>CM yielded only gummy products; those from the prepolymer 188 were more promising, and led to an additional four elastomers.

In order to formulate the prepolymer at an NCO ratio of 3:1 according to the following experimental plan:

PBD	Reaction of PBD with PBD			
	CSLS			
	IPDI		H <sub>12</sub> MDI	
Control Case	2 et. 1:3* Isonol	2 et. 1:3* Isonol	2 et. 1:3* Isonol	2 et. 1:3* Isonol
Estimated	199	200	197	198
	*2-ethyl 1:3 hexane diol			





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TABLE 1. *Phylogenetic relationships of the studied species, based on the analysis of the 16S rDNA sequence. The scale bar represents 0.001 substitutions per site*

[illegible]

<sup>1</sup>  $\mathcal{O}_X = \mathcal{O}_{\mathbb{P}^n}$  and  $\mathcal{O}_Y = \mathcal{O}_{\mathbb{P}^n}(-1)$  are the sheaves of regular functions on  $X$  and  $Y$ , respectively.

Test method to be compared	Standard test Method
Chemical analysis method	ASTM 6718
Gravimetric method	
Residue on 425 and water	ASTM 1044

TABLE 1. SUMMARY OF EVALUATION TESTS FOR RUBBER-CASTED FABRICS

Properties to be Measured	Standard Test Method
Tensile Strength	ASTM D 1004 Method A
Elongation at Break	Elongation at Break ASTM D 1004*
Impact Adhesion	ASTM D 1004 Method C
Flexural Fatigue	ASTM D 1004 Method C
Resistance to Low Temperature	ASTM D 1004 Method C
Water Wicking	Weight Gain
* A Neoprene-cast fabric strip was bonded to the rubber.	

## APPENDIX D DETAILED EXPERIMENTAL DATA

This appendix presents more detailed experimental data from which the averaged results were calculated and presented in the text. In most cases, the results for each test specimen are tabulated; in a few cases where the numerical spread in data was small, the maximum and minimum values are tabulated in addition to the average value, rather than each individual data point. Usually 3 to 5 data points were included in each average value.

Tables D.1 and D.2 are presented the crack growth and flexural fatigue data for the 7-gum rubber polymers and the 10-castable liquid polyurethane polymers, respectively. Results are presented for each of the three specimens which were evaluated for each polymer, and the generally large spread in results of this type of test is obvious.

Tables D.3 and D.4 contain the mechanical characterization data for the 7-gum rubber polymers and the 10-castable liquid polyurethane polymers which were selected for this phase of the program. Table D.5 presents the coating adhesion data. Tables D.6 and D.7 contain the Pin-abrasion test results for the 7-gum rubber polymers and the 10-castable liquid polyurethane polymers. Experimental results from the duplicate specimens which were evaluated with the Goodrich flexometer hysteresis test are listed in Tables D.8 and D.9 for the gum rubbers and polyurethanes, respectively. Plots of the temperature rise versus time for the various polymers are presented in Figures D.1, D.2, D.3, D.4, D.5, D.6, and D.7 for the gum rubbers and in Figures D.8, D.9, and D.10 for the polyurethane polymers.

More details of the experimental data characterizing the effects of water on the polymers are presented in Tables D.10 and D.11. Similarly, the effects of 95% immersion are presented in Tables D.12 and D.13.

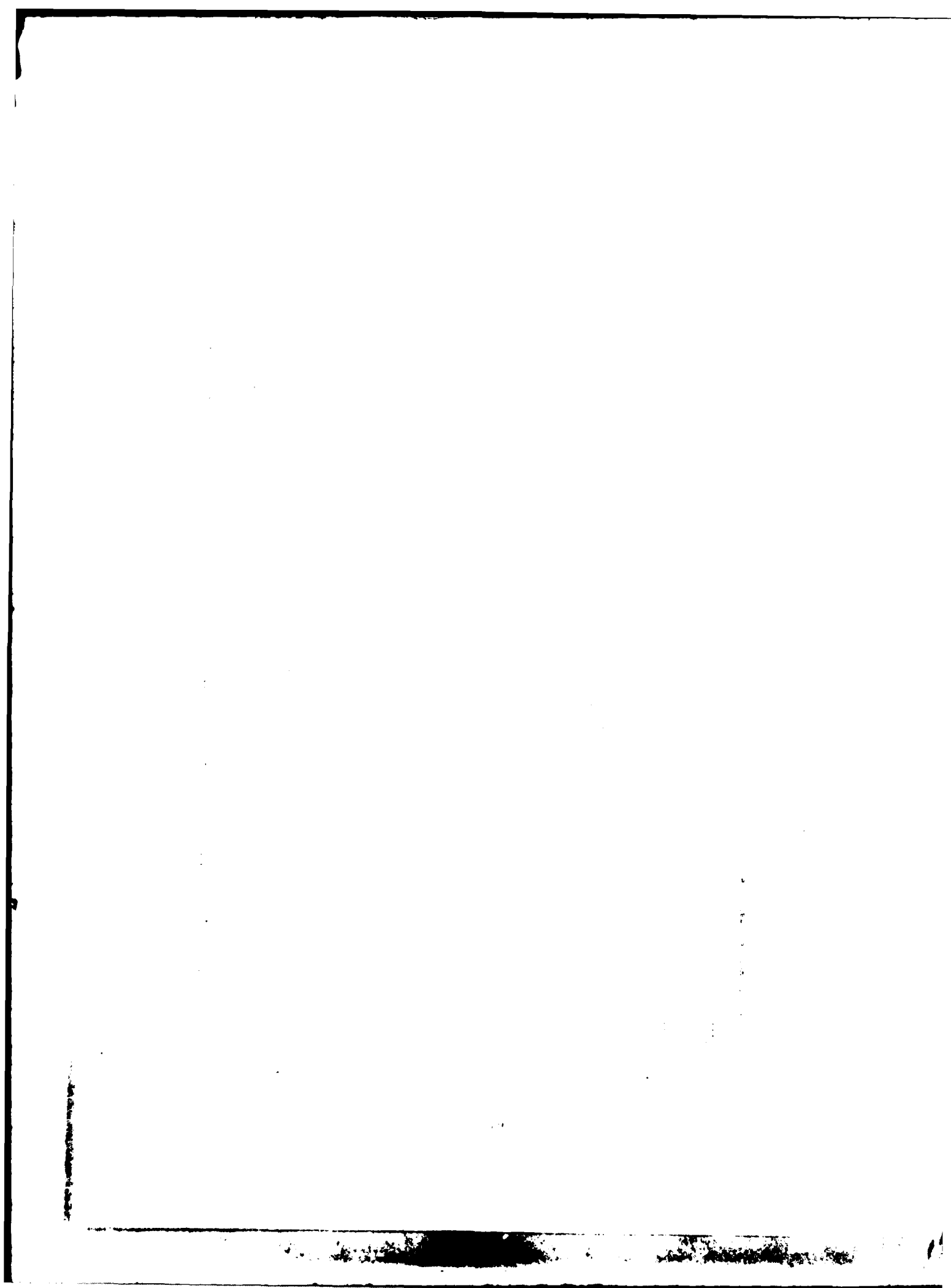
Tensile and elongation data for each specimen at three different test temperatures are presented in Table D.14 for the gum rubber polymer coated nylon fabric laminate and for the castable polyurethane polymer coated nylon fabric laminate in Table D.15. Similarly, tear strength results are presented in Tables D.16 and D.17. Coating adhesion results are presented in Table D.18 for polyurethane coated nylon fabric; the fabric and adhesion promoter were the same as used in the previous coating adhesion tests.



Results for the triplicate specimens of polymer-coated nylon fabric laminates were evaluated for chemical fatigue resistance in the deMott test, as reported in Tables 9.19 and 9.20.

Results for the triplicate specimens are presented as a function of exposure time in Figures 9.17 and 9.18.

Results for each laminate and fabric composite specimen are presented in Tables 9.1 (tensile strength), 9.2 (tear strength), and 9.3 (coating adhesion).





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Table 1. Physical and chemical data of the compounds.

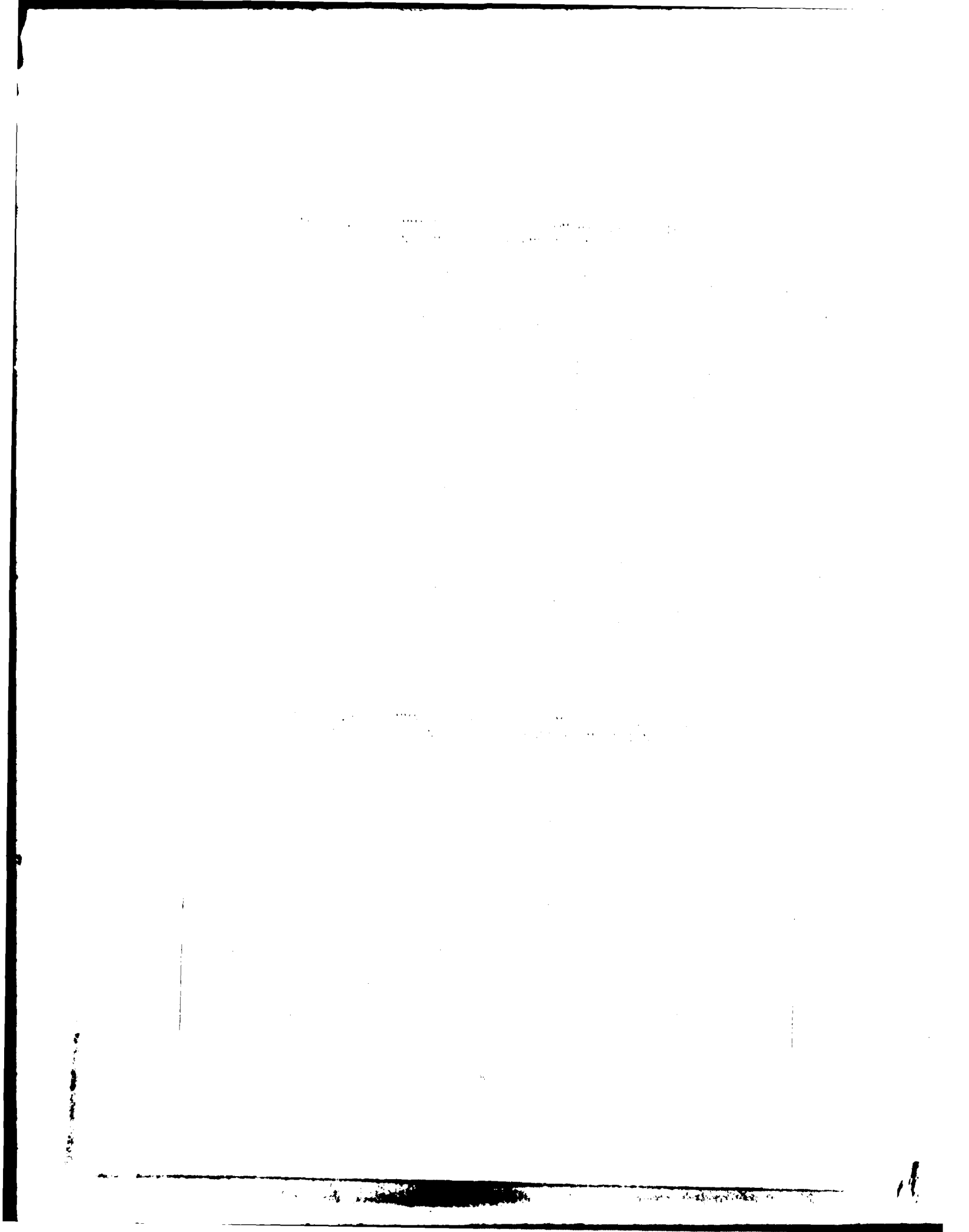
Compound	Yield (%)	mp (°C)	bp (°C)	lit.
1	85	102-103	140-141	[1]
2	78	105-106	145-146	[2]
3	72	108-109	150-151	[3]
4	65	110-111	155-156	[4]
5	58	112-113	160-161	[5]
6	52	115-116	165-166	[6]
7	45	118-119	170-171	[7]
8	38	120-121	175-176	[8]
9	32	122-123	180-181	[9]
10	25	125-126	185-186	[10]
11	18	128-129	190-191	[11]
12	12	130-131	195-196	[12]
13	8	132-133	200-201	[13]
14	5	135-136	205-206	[14]
15	3	138-139	210-211	[15]

mp = melting point; bp = boiling point; lit. = literature.

Table 2. Physical and chemical data of the compounds.

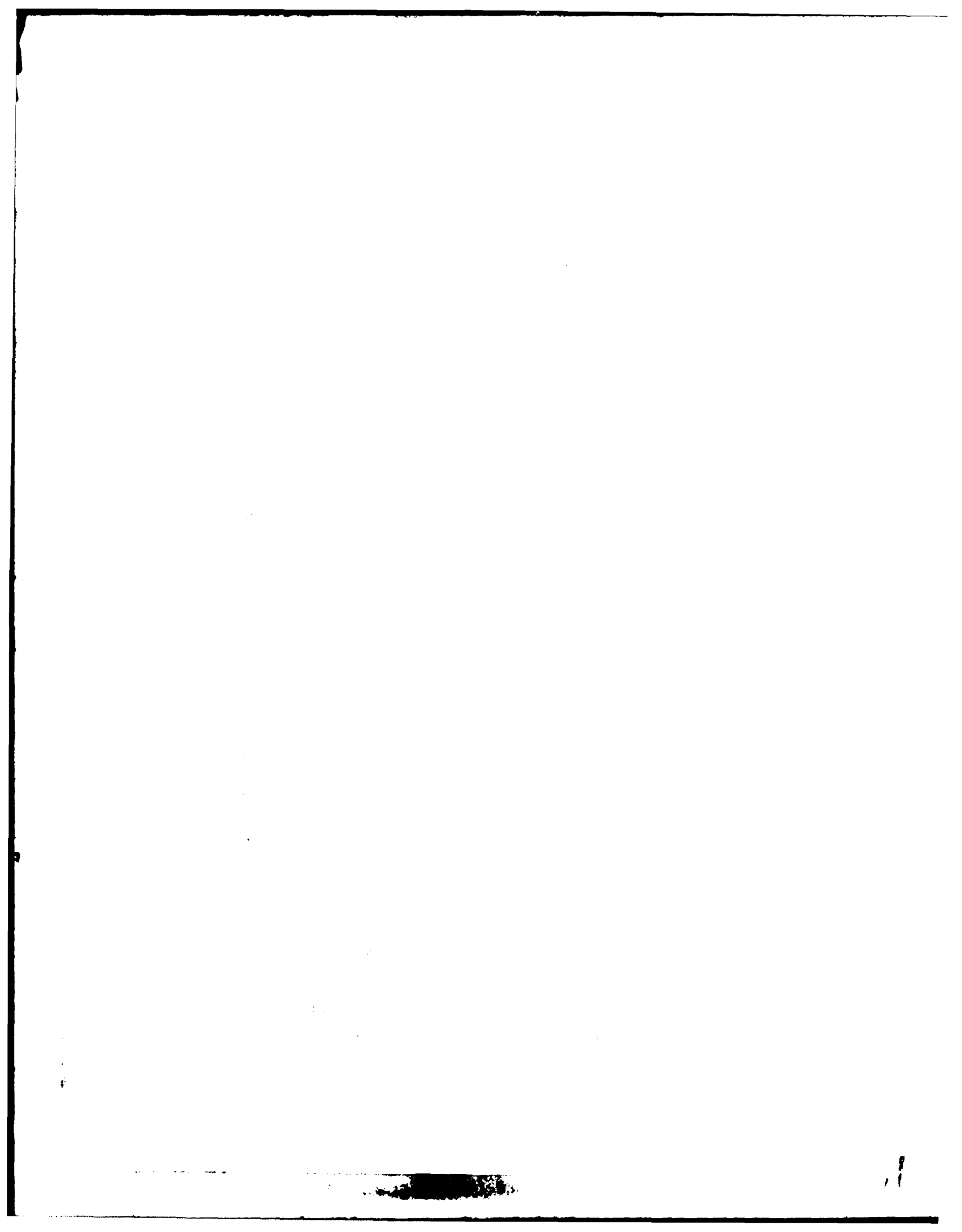
Compound	Yield (%)	mp (°C)	bp (°C)	lit.
16	82	100-101	135-136	[16]
17	75	103-104	140-141	[17]
18	68	106-107	145-146	[18]
19	60	109-110	150-151	[19]
20	53	112-113	155-156	[20]
21	46	115-116	160-161	[21]
22	39	118-119	165-166	[22]
23	32	121-122	170-171	[23]
24	25	124-125	175-176	[24]
25	18	127-128	180-181	[25]
26	12	130-131	185-186	[26]
27	8	133-134	190-191	[27]
28	5	136-137	195-196	[28]
29	3	139-140	200-201	[29]
30	2	142-143	205-206	[30]

mp = melting point; bp = boiling point; lit. = literature.









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FINGER MATERIALS FOR AIR CUSHION VEHICLES VOLUME 1  
FLEXIBLE COATINGS FOR (U) BELL AEROSPACE TEXTRON  
BUFFALO NY P K CONN ET AL DEC 84 7467-927048-VOL-1  
DTNSRDC-85/003 N00600-78-**C-0250**

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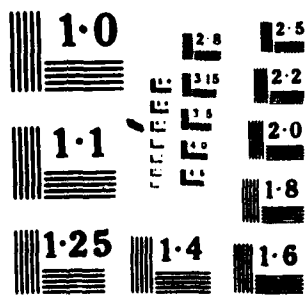




TABLE D-13 - MECHANICAL PROPERTIES OF POLYETHYLENE FORMULATIONS BEFORE AND AFTER EXTENSION IN H-1 STEEL

Formulation No.	Formulation Data			Mechanical Properties			After Extension in H-1 Steel		
	Dist.	Ex. (mm)	Station	Modulus (psi)	Yield (psi)	Tensile (psi)	Modulus (psi)	Yield (psi)	Tensile (psi)
181	2000 MW	100	50	1000	1000	1000	1000	1000	1000
PTMOC									
185	PBC Styrene	100	50	1000	1000	1000	1000	1000	1000
Cap. (mm)									
188	PBC Styrene	100	50	1000	1000	1000	1000	1000	1000
Cap. (mm)									
195	PTMOC	100	50	1000	1000	1000	1000	1000	1000
2000 MW (2000 MW) 100 50 1000 1000 1000 1000 1000 1000									
400 rate									

\* Temperature of test was at 100°C.

TABLE D.1.4 - TEST III RESULTS FROM RUBBER/ KOVIN NYLON COMPOSITE

TEST NO.	TEST TYPE	TEST RESULT	TEST RESULT	TEST RESULT	TEST RESULT
1	100	100	100	100	100
2	100	100	100	100	100
3	100	100	100	100	100
4	100	100	100	100	100
5	100	100	100	100	100
6	100	100	100	100	100
7	100	100	100	100	100
8	100	100	100	100	100
9	100	100	100	100	100
10	100	100	100	100	100
11	100	100	100	100	100
12	100	100	100	100	100
13	100	100	100	100	100
14	100	100	100	100	100
15	100	100	100	100	100
16	100	100	100	100	100
17	100	100	100	100	100
18	100	100	100	100	100
19	100	100	100	100	100
20	100	100	100	100	100
21	100	100	100	100	100
22	100	100	100	100	100
23	100	100	100	100	100
24	100	100	100	100	100
25	100	100	100	100	100
26	100	100	100	100	100
27	100	100	100	100	100
28	100	100	100	100	100
29	100	100	100	100	100
30	100	100	100	100	100
31	100	100	100	100	100
32	100	100	100	100	100
33	100	100	100	100	100
34	100	100	100	100	100
35	100	100	100	100	100
36	100	100	100	100	100
37	100	100	100	100	100
38	100	100	100	100	100
39	100	100	100	100	100
40	100	100	100	100	100
41	100	100	100	100	100
42	100	100	100	100	100
43	100	100	100	100	100
44	100	100	100	100	100
45	100	100	100	100	100
46	100	100	100	100	100
47	100	100	100	100	100
48	100	100	100	100	100
49	100	100	100	100	100
50	100	100	100	100	100
51	100	100	100	100	100
52	100	100	100	100	100
53	100	100	100	100	100
54	100	100	100	100	100
55	100	100	100	100	100
56	100	100	100	100	100
57	100	100	100	100	100
58	100	100	100	100	100
59	100	100	100	100	100
60	100	100	100	100	100
61	100	100	100	100	100
62	100	100	100	100	100
63	100	100	100	100	100
64	100	100	100	100	100
65	100	100	100	100	100
66	100	100	100	100	100
67	100	100	100	100	100
68	100	100	100	100	100
69	100	100	100	100	100
70	100	100	100	100	100
71	100	100	100	100	100
72	100	100	100	100	100
73	100	100	100	100	100
74	100	100	100	100	100
75	100	100	100	100	100
76	100	100	100	100	100
77	100	100	100	100	100
78	100	100	100	100	100
79	100	100	100	100	100
80	100	100	100	100	100
81	100	100	100	100	100
82	100	100	100	100	100
83	100	100	100	100	100
84	100	100	100	100	100
85	100	100	100	100	100
86	100	100	100	100	100
87	100	100	100	100	100
88	100	100	100	100	100
89	100	100	100	100	100
90	100	100	100	100	100

TABLE D.14 - (Continued)

Material	Condition	Average Thickness (in.)	Test Temperature (°C)	Tensile Strength (lbs./in.)	Average	Elongation (%)	Average
A36	A111	0.412	24 (75.0)	1020	1042	33	26
			24 (75.0)	1086		24	
			24 (75.0)	993		25	
			24 (75.0)	1072		31	
			24 (75.0)	1072		33	
	A120	0.412	24 (75.0)	1043	1067	25	29
			24 (75.0)	1117		30	
			24 (75.0)	1061		30	
			24 (75.0)	1063		28	
			24 (75.0)	1086		31	
	A130	0.412	24 (75.0)	1180	1143	28	25
			24 (75.0)	1086		24	
			24 (75.0)	1143		29	
			24 (75.0)	1200		28	
			24 (75.0)	1147		20	
A572	A111	0.412	24 (75.0)	1033	1063	30	24
			24 (75.0)	964		31	
			24 (75.0)	987		28	
			24 (75.0)	1006		28	
			24 (75.0)	1033		28	
	A120	0.412	24 (75.0)	1020	1041	30	24
			24 (75.0)	1039		38	
			24 (75.0)	1086		34	
			24 (75.0)	1092		38	
			24 (75.0)	1070		37	
	A130	0.412	24 (75.0)	1008	990	28	32
			24 (75.0)	970		28	
			24 (75.0)	894		32	
			24 (75.0)	987		34	
			24 (75.0)	981		24	
A572	A111	0.412	24 (75.0)	987	1029	14	17
			24 (75.0)	1086		19	
			24 (75.0)	987		17	
			24 (75.0)	1033		16	
			24 (75.0)	1033		20	
	A120	0.412	24 (75.0)	1003	1033	28	28
			24 (75.0)	1006		26	
			24 (75.0)	1020		26	
			24 (75.0)	1099		30	
			24 (75.0)	1046		30	



TABLE D.14 - (Continued)

Material	Specimen No.	Weave Direction	Test Temperature (°C) (°F)	Tensile Strength (lbs.) (N)	Average	Elongation (%)	Average
	11		-1 (30)	1092	1068	35	27
	12		-1 (30)	1042			
	13		-1 (30)	1084		20	
	14		-1 (30)	974		32	
	15		-1 (30)	1041		14	
BAT 418	1	Warp	24 (75)	1127	1130	39	34
	2		24 (75)	1049		39	
	3		24 (75)	1131		39	
	4		24 (75)	1131		36	
	5		24 (75)	1131		36	
	6		29 (120)				
	7		29 (120)				
	8		29 (120)	Testing cancelled, material softened.			
	9		29 (120)				
	10		29 (120)				
	11		-1 (30)				
	12		-1 (30)				
	13		-1 (30)	Testing cancelled.			
	14		-1 (30)				
	15		-1 (30)				
	1	1111	24 (75)	1118	1131	39	36
	2		24 (75)	1224		36	
	3		24 (75)	1125		30	
	4		24 (75)	1220		29	
	5		24 (75)	1316		29	
	6		29 (120)	1152	1176	25	28
	7		29 (120)	Rubber covering gave-way first pull; spec. repositioned and test completed. 1289			
	8		29 (120)	(Test temperature > 110°F) First test at 120°F; rubber gave-way.			
	9		29 (120)	Rubber covering softened and was separated from fabric by grip. 1089			
	10		29 (120)	(Test Temperature < 110°F)			
	11		-1 (30)	Testing cancelled.			
	12		-1 (30)				
	13						
	14						
	15						

TABLE 10.13 - TENSILE RESULTS FROM POLYMERBLENDED NYLON  
NYLON COMPOUNDS

Material	Specimen No.	Warp Direction	Test Temperature, °F.	Material Avg. Stress, lbs./sq. in.	Tensile Strength, lbs./sq. in.	Elongation, %
180 - Nylon Fabric	1	Warp	24 (75)	0,185	1040	35
	2	Warp	24 (75)	0,184	1100	35
	3	Warp	24 (75)	0,190	1160	30
				Avg. 1100	Avg. 37	
	4	Warp	49 (120)	0,177	1150	40
	5	Warp	49 (120)	0,198	1030	40
	6	Warp	49 (120)	0,195	1100	35
	7	Warp	49 (120)	0,207	1040	32
				Avg. 1080	Avg. 37	
180 - Nylon Fabric	1	F111	24 (75)	0,184	830	20
	2	F111	24 (75)	0,186	1180	25
	3	F111	24 (75)	0,185	1170	30
	4	F111	24 (75)	0,191	1290	25
				Avg. 1120	Avg. 25	
	5	F111	49 (120)	0,168	1120	30
	6	F111	49 (120)	0,172	970	35
	7	F111	49 (120)	0,186	1170	28
	8	F111	49 (120)	0,187	1000	22
				Avg. 1070	Avg. 28	
180 - Nylon Fabric	1	Warp	24 (75)	0,140	1140	35
	2	Warp	24 (75)	0,140	1180	30
	3	Warp	24 (75)	0,139	1060	30
	4	Warp	24 (75)	0,140	1240	38
				Avg. 1170	Avg. 34	
	5	Warp	49 (120)	0,140	1060	31
	6	Warp	49 (120)	0,144	1000	40
	7	Warp	49 (120)	0,146	1100	32
	8	Warp	49 (120)	0,146	1080	31
				Avg. 1080	Avg. 34	
180 - Nylon Fabric	1	F111	24 (75)	0,141	1120	25
	2	F111	24 (75)	0,150	1100	22
	3	F111	24 (75)	0,169	1170	26
	4	F111	24 (75)	0,150	1220	25
				Avg. 1160	Avg. 25	
	5	F111	49 (120)	0,151	950	25
	6	F111	49 (120)	0,150	875	23
	7	F111	49 (120)	0,152	970	28
	8	F111	49 (120)	0,150	1030	22
				Avg. 960	Avg. 25	



TABLE 1. SUMMARY OF DATA FOR THE 1960-1961 SEASON				
Station	Location	Altitude (ft)	Area (sq ft)	Volume (cu ft)
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	...	...	...	...
6	...	...	...	...
7	...	...	...	...
8	...	...	...	...
9	...	...	...	...
10	...	...	...	...
11	...	...	...	...
12	...	...	...	...
13	...	...	...	...
14	...	...	...	...
15	...	...	...	...
16	...	...	...	...
17	...	...	...	...
18	...	...	...	...
19	...	...	...	...
20	...	...	...	...
21	...	...	...	...
22	...	...	...	...
23	...	...	...	...
24	...	...	...	...
25	...	...	...	...
26	...	...	...	...
27	...	...	...	...
28	...	...	...	...
29	...	...	...	...
30	...	...	...	...
31	...	...	...	...
32	...	...	...	...
33	...	...	...	...
34	...	...	...	...
35	...	...	...	...
36	...	...	...	...
37	...	...	...	...
38	...	...	...	...
39	...	...	...	...
40	...	...	...	...
41	...	...	...	...
42	...	...	...	...
43	...	...	...	...
44	...	...	...	...
45	...	...	...	...
46	...	...	...	...
47	...	...	...	...
48	...	...	...	...
49	...	...	...	...
50	...	...	...	...
51	...	...	...	...
52	...	...	...	...
53	...	...	...	...
54	...	...	...	...
55	...	...	...	...
56	...	...	...	...
57	...	...	...	...
58	...	...	...	...
59	...	...	...	...
60	...	...	...	...
61	...	...	...	...
62	...	...	...	...
63	...	...	...	...
64	...	...	...	...
65	...	...	...	...
66	...	...	...	...
67	...	...	...	...
68	...	...	...	...
69	...	...	...	...
70	...	...	...	...
71	...	...	...	...
72	...	...	...	...
73	...	...	...	...
74	...	...	...	...
75	...	...	...	...
76	...	...	...	...
77	...	...	...	...
78	...	...	...	...
79	...	...	...	...
80	...	...	...	...
81	...	...	...	...
82	...	...	...	...
83	...	...	...	...
84	...	...	...	...
85	...	...	...	...
86	...	...	...	...
87	...	...	...	...
88	...	...	...	...
89	...	...	...	...
90	...	...	...	...
91	...	...	...	...
92	...	...	...	...
93	...	...	...	...
94	...	...	...	...
95	...	...	...	...
96	...	...	...	...
97	...	...	...	...
98	...	...	...	...
99	...	...	...	...
100	...	...	...	...

TABLE 2. SUMMARY OF DATA FOR THE 1962-1963 SEASON

TABLE 2. SUMMARY OF DATA FOR THE 1962-1963 SEASON				
Station	Location	Altitude (ft)	Area (sq ft)	Volume (cu ft)
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	...	...	...	...
6	...	...	...	...
7	...	...	...	...
8	...	...	...	...
9	...	...	...	...
10	...	...	...	...
11	...	...	...	...
12	...	...	...	...
13	...	...	...	...
14	...	...	...	...
15	...	...	...	...
16	...	...	...	...
17	...	...	...	...
18	...	...	...	...
19	...	...	...	...
20	...	...	...	...
21	...	...	...	...
22	...	...	...	...
23	...	...	...	...
24	...	...	...	...
25	...	...	...	...
26	...	...	...	...
27	...	...	...	...
28	...	...	...	...
29	...	...	...	...
30	...	...	...	...
31	...	...	...	...
32	...	...	...	...
33	...	...	...	...
34	...	...	...	...
35	...	...	...	...
36	...	...	...	...
37	...	...	...	...
38	...	...	...	...
39	...	...	...	...
40	...	...	...	...
41	...	...	...	...
42	...	...	...	...
43	...	...	...	...
44	...	...	...	...
45	...	...	...	...
46	...	...	...	...
47	...	...	...	...
48	...	...	...	...
49	...	...	...	...
50	...	...	...	...
51	...	...	...	...
52	...	...	...	...
53	...	...	...	...
54	...	...	...	...
55	...	...	...	...
56	...	...	...	...
57	...	...	...	...
58	...	...	...	...
59	...	...	...	...
60	...	...	...	...
61	...	...	...	...
62	...	...	...	...
63	...	...	...	...
64	...	...	...	...
65	...	...	...	...
66	...	...	...	...
67	...	...	...	...
68	...	...	...	...
69	...	...	...	...
70	...	...	...	...
71	...	...	...	...
72	...	...	...	...
73	...	...	...	...
74	...	...	...	...
75	...	...	...	...
76	...	...	...	...
77	...	...	...	...
78	...	...	...	...
79	...	...	...	...
80	...	...	...	...
81	...	...	...	...
82	...	...	...	...
83	...	...	...	...
84	...	...	...	...
85	...	...	...	...
86	...	...	...	...
87	...	...	...	...
88	...	...	...	...
89	...	...	...	...
90	...	...	...	...
91	...	...	...	...
92	...	...	...	...
93	...	...	...	...
94	...	...	...	...
95	...	...	...	...
96	...	...	...	...
97	...	...	...	...
98	...	...	...	...
99	...	...	...	...
100	...	...	...	...

TABLE 1. Static and Dynamic Properties of Specimens  
 (a) Static Properties of Specimens

Material Description	Test		Nominal Properties	
	Temperature (°C)	Deflection (mm)	Load (kN)	Displacement (mm)
FIBERGLASS/NETWORK WARP	1	0.000	1.810 <sup>6</sup>	1.11
	20	0.120	1.810 <sup>6</sup>	1.11
	100	0.000	1.810 <sup>6</sup>	1.11
	200	0.120	1.810 <sup>6</sup>	1.11
FIBERGLASS/NETWORK WARP	1	0.000	1.810 <sup>6</sup>	1.11
	20	0.120	1.810 <sup>6</sup>	1.11
	100	0.000	1.810 <sup>6</sup>	1.11
	200	0.120	1.810 <sup>6</sup>	1.11
FIBERGLASS/NETWORK WARP	1	0.000	1.810 <sup>6</sup>	1.11
	20	0.120	1.810 <sup>6</sup>	1.11
	100	0.000	1.810 <sup>6</sup>	1.11
	200	0.120	1.810 <sup>6</sup>	1.11
FIBERGLASS/NETWORK WARP	1	0.000	1.810 <sup>6</sup>	1.11
	20	0.120	1.810 <sup>6</sup>	1.11
	100	0.000	1.810 <sup>6</sup>	1.11
	200	0.120	1.810 <sup>6</sup>	1.11
FIBERGLASS/NETWORK WARP	1	0.000	1.810 <sup>6</sup>	1.11
	20	0.120	1.810 <sup>6</sup>	1.11
	100	0.000	1.810 <sup>6</sup>	1.11
	200	0.120	1.810 <sup>6</sup>	1.11
FIBERGLASS/NETWORK WARP	1	0.000	1.810 <sup>6</sup>	1.11
	20	0.120	1.810 <sup>6</sup>	1.11
	100	0.000	1.810 <sup>6</sup>	1.11
	200	0.120	1.810 <sup>6</sup>	1.11
FIBERGLASS/NETWORK WARP	1	0.000	1.810 <sup>6</sup>	1.11
	20	0.120	1.810 <sup>6</sup>	1.11
	100	0.000	1.810 <sup>6</sup>	1.11
	200	0.120	1.810 <sup>6</sup>	1.11

• The static test results are based on the static test results of the specimens.  
 • Specimens exhibited no significant improvement in strength.  
 • Specimens exhibited some improvement in strength and ductility.

**GENERAL STATEMENT OF THE ACCOUNTS OF THE  
REVENUE DEPARTMENT**

The following statement shows the result of the operations of the Revenue Department for the year ending 1900. It is prepared from the accounts of the various divisions of the Department, and is intended to give a general view of the results of the operations of the Department as a whole.

The statement is divided into two main parts, the first of which shows the results of the operations of the various divisions of the Department, and the second of which shows the results of the operations of the Department as a whole.

The first part of the statement is divided into two main sections, the first of which shows the results of the operations of the various divisions of the Department, and the second of which shows the results of the operations of the Department as a whole.

**STATEMENT OF THE RESULTS OF THE OPERATIONS OF THE  
REVENUE DEPARTMENT FOR THE YEAR ENDING 1900**

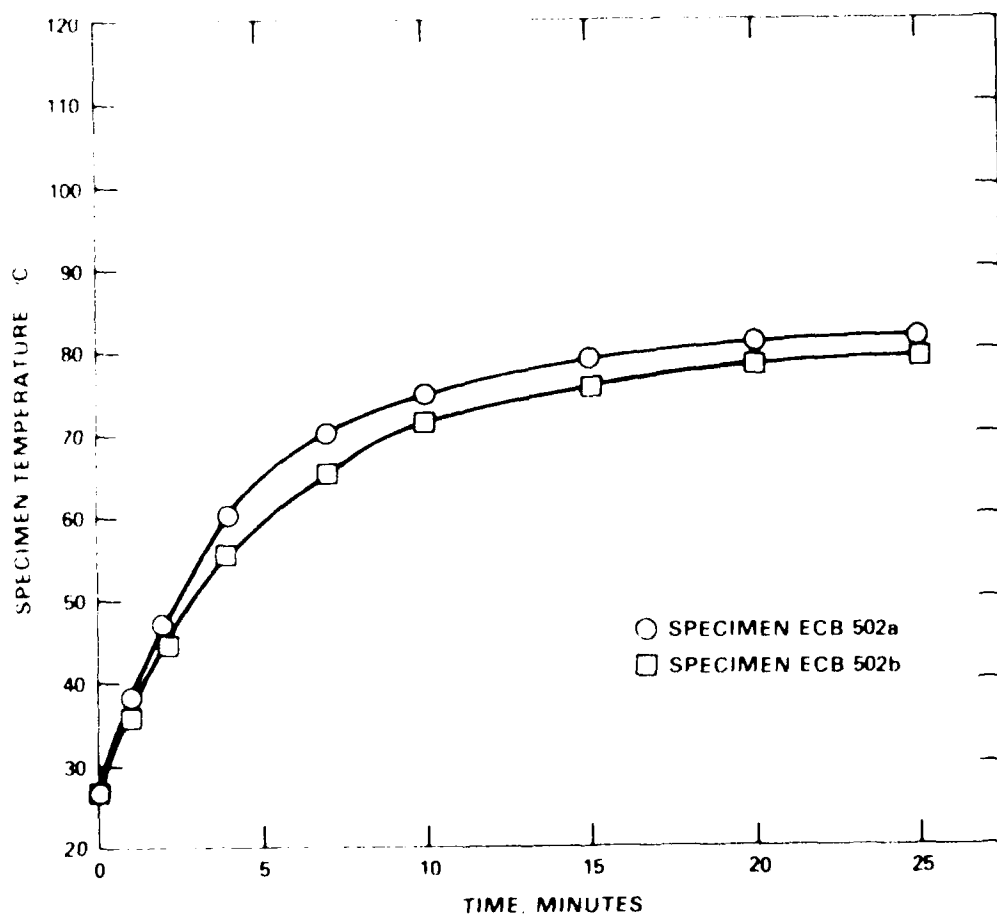
Division	Receipts	Disbursements	Balance	Total	Percentage
Alcohol and Wine	1,000,000	500,000	500,000	1,500,000	33.33
Tobacco	800,000	400,000	400,000	1,200,000	33.33
Salt	600,000	300,000	300,000	900,000	33.33
Stamps	400,000	200,000	200,000	600,000	33.33
Other	200,000	100,000	100,000	300,000	33.33
<b>Total</b>	<b>3,000,000</b>	<b>1,500,000</b>	<b>1,500,000</b>	<b>4,500,000</b>	<b>33.33</b>
Alcohol and Wine	1,000,000	500,000	500,000	1,500,000	33.33
Tobacco	800,000	400,000	400,000	1,200,000	33.33
Salt	600,000	300,000	300,000	900,000	33.33
Stamps	400,000	200,000	200,000	600,000	33.33
Other	200,000	100,000	100,000	300,000	33.33
<b>Total</b>	<b>3,000,000</b>	<b>1,500,000</b>	<b>1,500,000</b>	<b>4,500,000</b>	<b>33.33</b>
Alcohol and Wine	1,000,000	500,000	500,000	1,500,000	33.33
Tobacco	800,000	400,000	400,000	1,200,000	33.33
Salt	600,000	300,000	300,000	900,000	33.33
Stamps	400,000	200,000	200,000	600,000	33.33
Other	200,000	100,000	100,000	300,000	33.33
<b>Total</b>	<b>3,000,000</b>	<b>1,500,000</b>	<b>1,500,000</b>	<b>4,500,000</b>	<b>33.33</b>

TABLE 1. DATA FROM SOLUBLE MANIPULATOR AND COMPOSITE

Material	Sample No.	Test	Temp.	Pressure
Soluble Manipulator	1	1000	100	100
	2	1000	100	100
	3	1000	100	100
	4	1000	100	100
	5	1000	100	100
	6	1000	100	100
	7	1000	100	100
	8	1000	100	100
	9	1000	100	100
	10	1000	100	100
Composite	11	1000	100	100
	12	1000	100	100
	13	1000	100	100
	14	1000	100	100
	15	1000	100	100
	16	1000	100	100
	17	1000	100	100
	18	1000	100	100
	19	1000	100	100
	20	1000	100	100

TABLE 2. DATA FROM SOLUBLE MANIPULATOR AND COMPOSITE

Material	Sample No.	Test	Temp.	Pressure
Soluble Manipulator	1	1000	100	100
	2	1000	100	100
	3	1000	100	100





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1. *Journal of the American Medical Association*, 1997; 277: 1039-1043.

1 2 3 4 5

4. *Chlorophyll a* and *Chlorophyll b* (mg/g)

As a result, the model is able to capture the nonlinear relationship between the variables. The model is also able to capture the interaction between the variables. The model is also able to capture the nonlinearity of the relationship between the variables. The model is also able to capture the nonlinearity of the relationship between the variables.

the 1990s, the number of people in the world who are illiterate has increased from 1.2 billion to 1.5 billion. The number of illiterate people in the world is expected to reach 1.7 billion by the year 2015. The number of illiterate people in the world is expected to reach 1.7 billion by the year 2015.

1. *Chlorophyll a* and *Chlorophyll b* were determined using a spectrophotometer (Shimadzu UV-1601) at 663 nm and 646 nm, respectively. The concentrations of *Chlorophyll a* and *Chlorophyll b* were calculated using the following equations:  $Chl\ a = 12.7 \times OD_{663} - 2.13 \times OD_{646}$  and  $Chl\ b = 22.9 \times OD_{646} - 4.68 \times OD_{663}$  (Morel and Wainman 1995).

[illegible][illegible]

1. *Journal of the Philosophy of Education Society of Great Britain*, 1990, 19, 1.  
 2. *Journal of the Philosophy of Education Society of Great Britain*, 1990, 19, 1.  
 3. *Journal of the Philosophy of Education Society of Great Britain*, 1990, 19, 1.  
 4. *Journal of the Philosophy of Education Society of Great Britain*, 1990, 19, 1.

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 The authors thank the following:

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P.O. Box 6000  
Midland, MI 48686



# APPENDIX

## 1. SUMMARY OF RESULTS OF EXPERIMENT 1

Summary of results of Experiment 1 are shown in Table 1. The data are presented in terms of the number of correct responses and the percentage of correct responses for each condition. The data are presented in terms of the number of correct responses and the percentage of correct responses for each condition.

Condition	Number of Correct Responses	Percentage of Correct Responses
Control	100	100%
Low	95	95%
High	90	90%
Very High	85	85%
Extremely High	80	80%

The data show that the number of correct responses decreased as the level of difficulty increased. The percentage of correct responses also decreased as the level of difficulty increased.

## 2. DISCUSSION

The results of Experiment 1 show that the number of correct responses decreased as the level of difficulty increased. The percentage of correct responses also decreased as the level of difficulty increased. This suggests that the subjects were able to perform the task at a lower level of difficulty but were unable to perform the task at a higher level of difficulty. This is consistent with the hypothesis that the subjects were unable to perform the task at a higher level of difficulty because they were unable to maintain the required level of attention.

## 3. REFERENCES

1. Smith, J. (1978). The effects of task difficulty on performance. *Journal of Experimental Psychology*, 113, 1-10.
2. Jones, D. (1980). The effects of task difficulty on performance. *Journal of Experimental Psychology*, 115, 1-10.
3. Brown, E. (1982). The effects of task difficulty on performance. *Journal of Experimental Psychology*, 117, 1-10.

The data for the studies tested are shown in the following table.

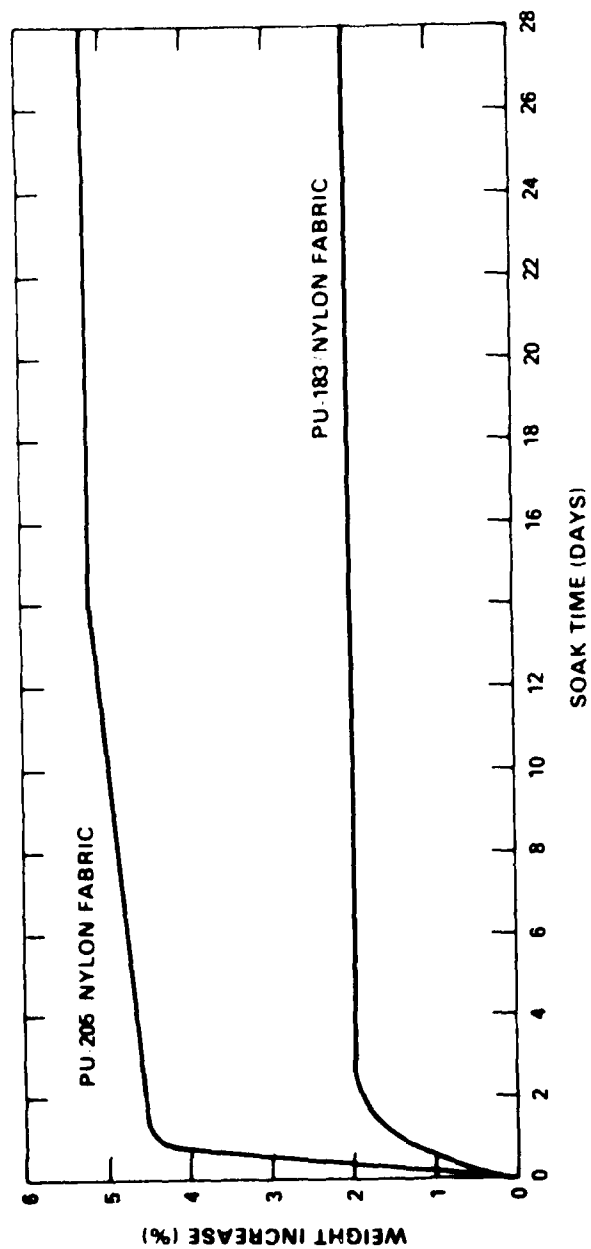
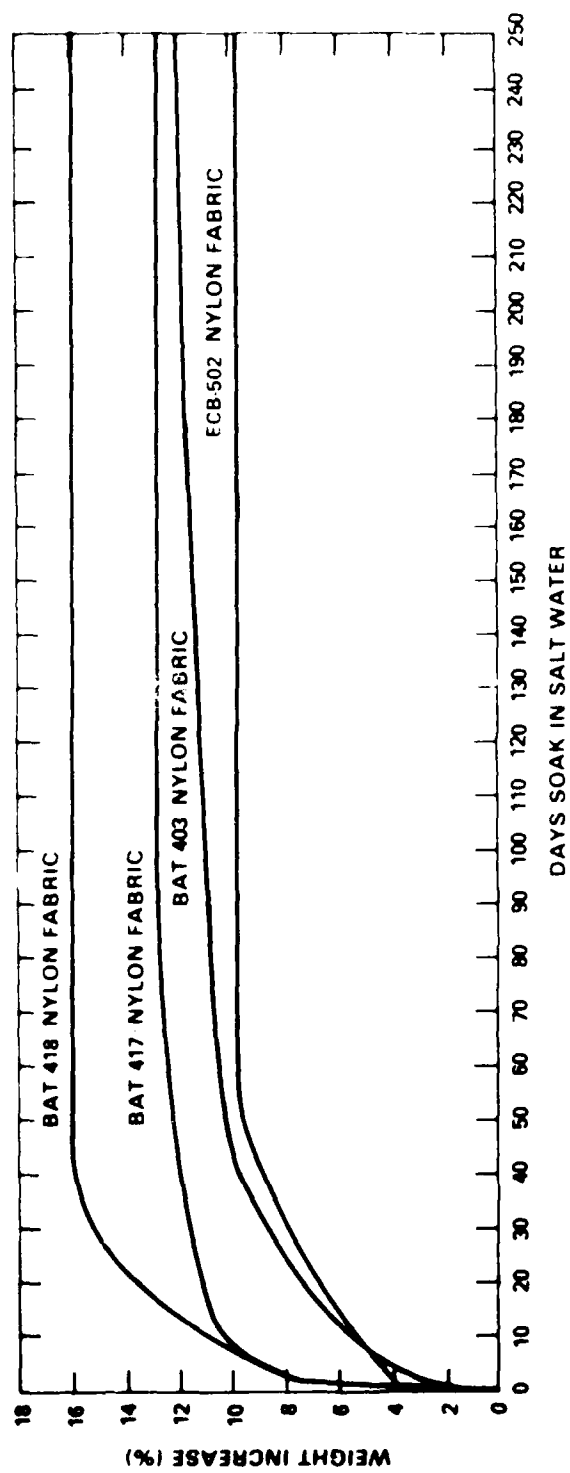


Figure 10. Weight increase of nylon fabric in water at 25°C.



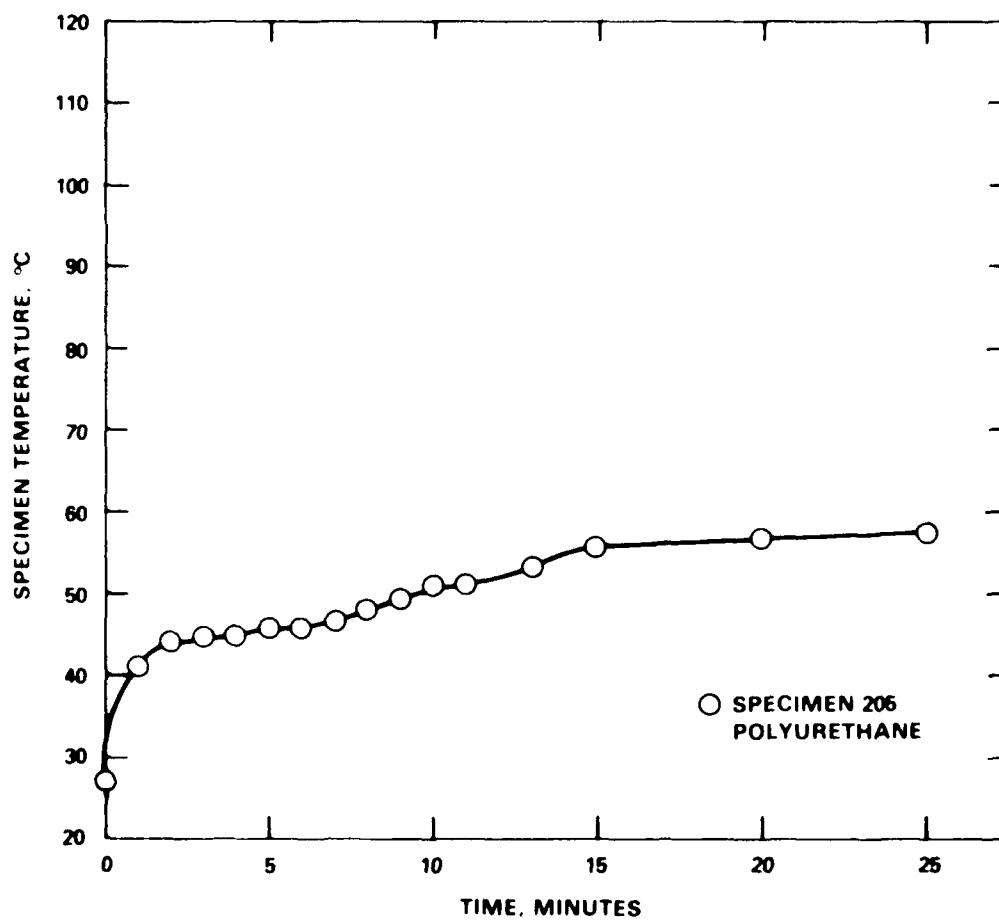


Figure 1. Specimen temperature rise during curing cycle. The curing cycle consists of 10 minutes at 100°C per Minute Super Imposition on a base temperature of 1.6 Pounds per square inch.

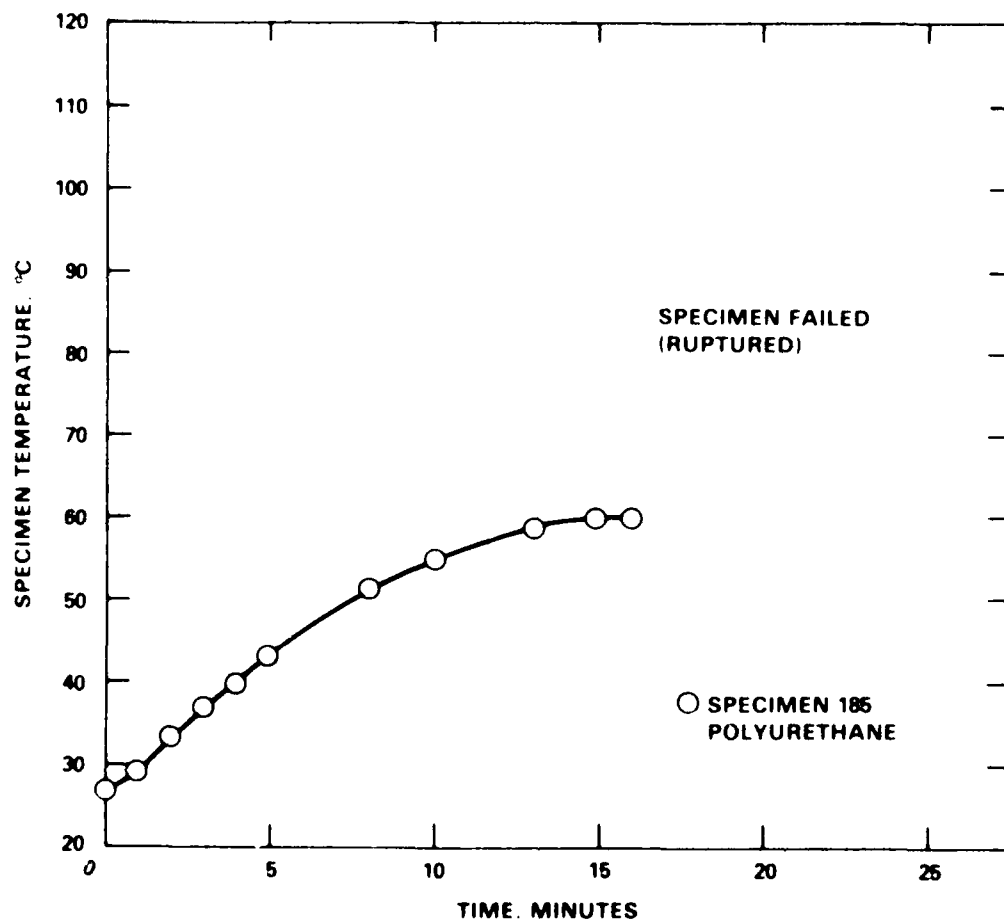


Figure 10. Specimen Temperature History During Static Compressive Loading at 1000 psi per Minute Superimposed on a Compressive Loading of 100 Pounds per Square Inch

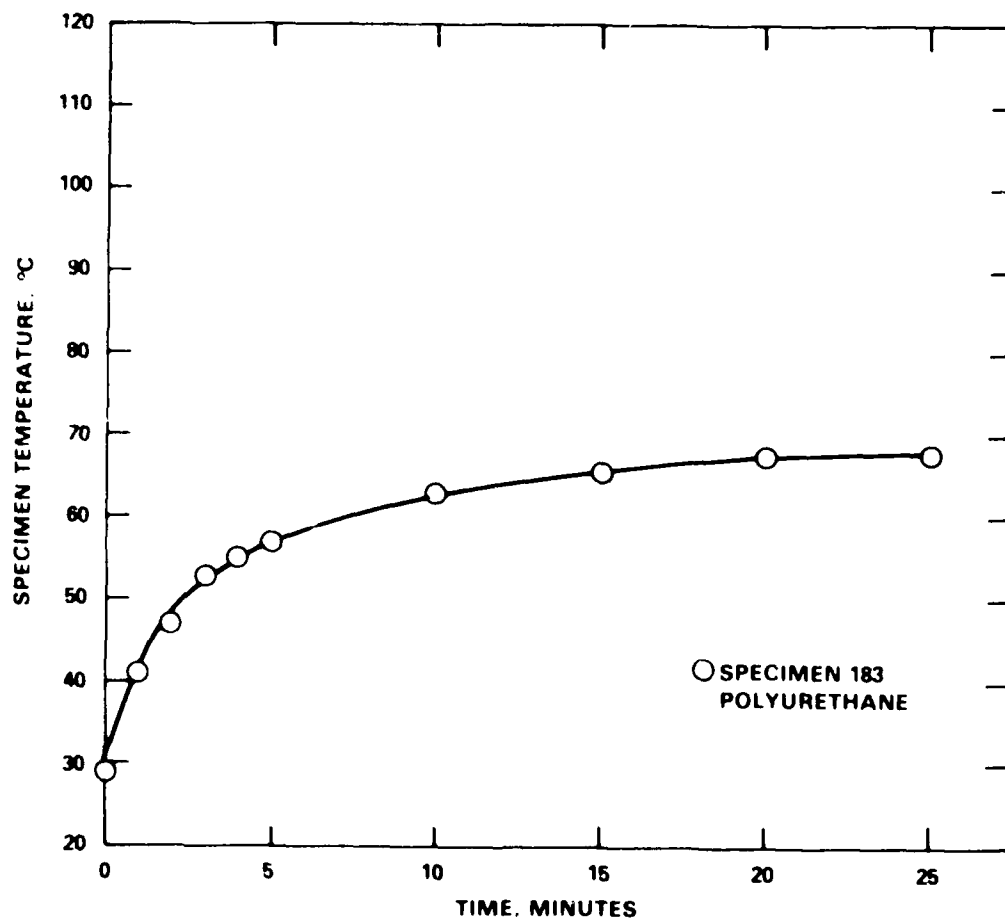


Figure 10. Specimen temperature versus time during one-half compressive loading at 1000 psi. One per Minute Superimposed on a Compressive Loading of 1.3 Pound per Square Inch.



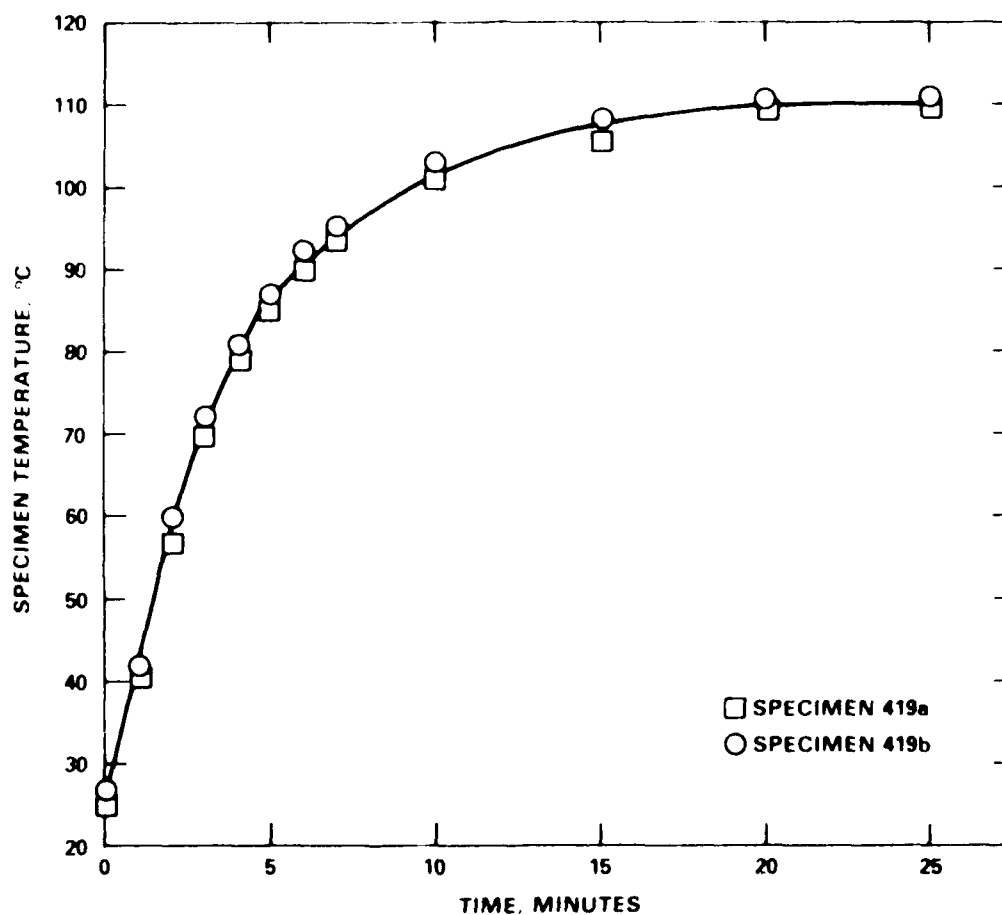


Figure 1. Specimen temperature (°C) vs. time (minutes) for Specimen 419a and Specimen 419b. The temperature of the specimens was measured at 1-minute intervals. The temperature of the specimens was measured at 1-minute intervals. The temperature of the specimens was measured at 1-minute intervals.

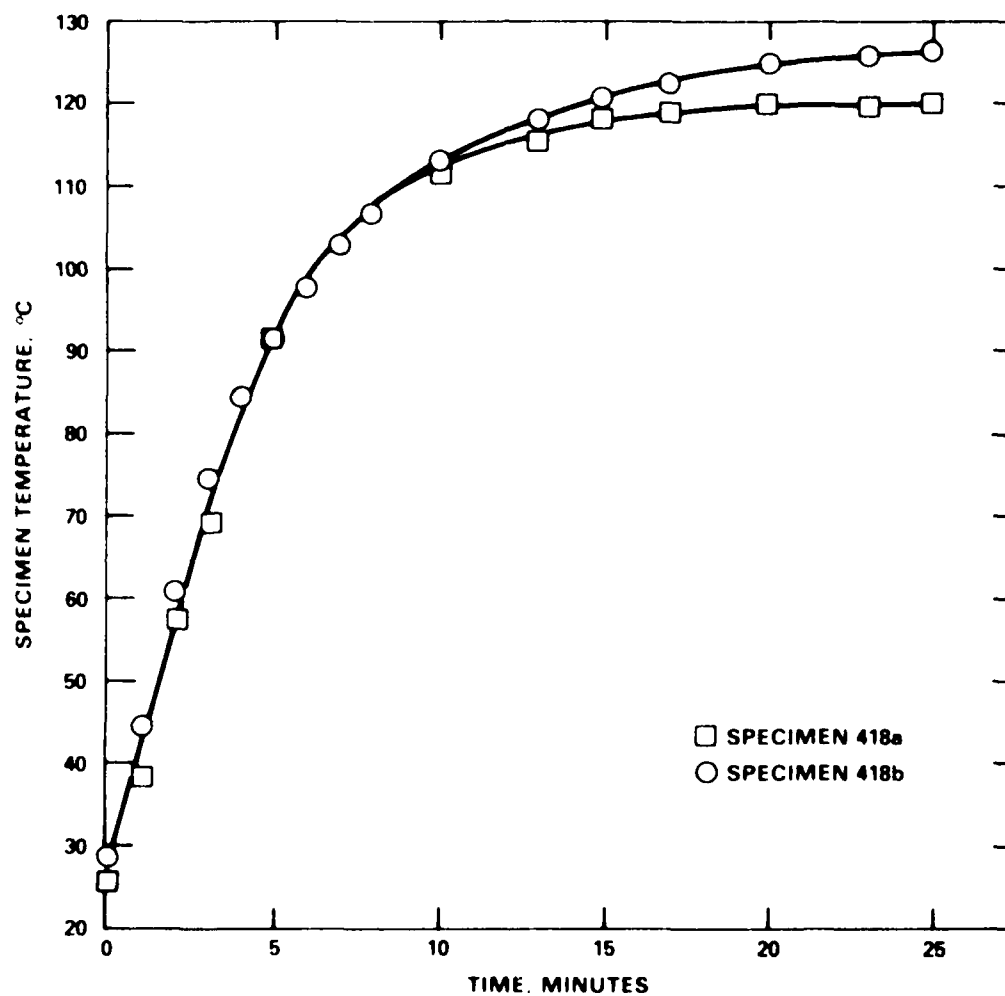


Figure 10. Temperature history of specimens during failure. Compressive strength of 100,000 psi was reached after 10 minutes, resulting in a compressive strain of 0.0025 in./in. and a lateral strain of 0.0012 in./in.

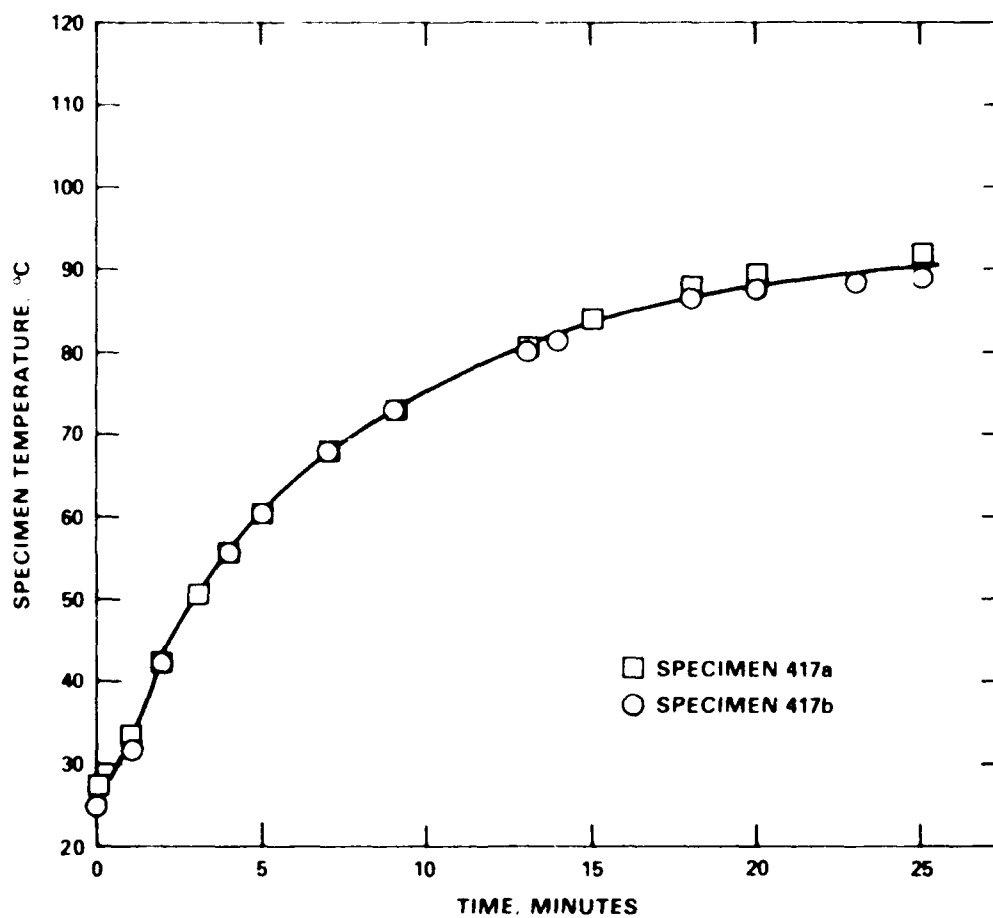


Figure 1. Specimen temperature vs. time for specimens 417a and 417b. The temperature of the specimens was measured at 1-minute intervals. The temperature of the specimens was measured at 1-minute intervals. The temperature of the specimens was measured at 1-minute intervals.

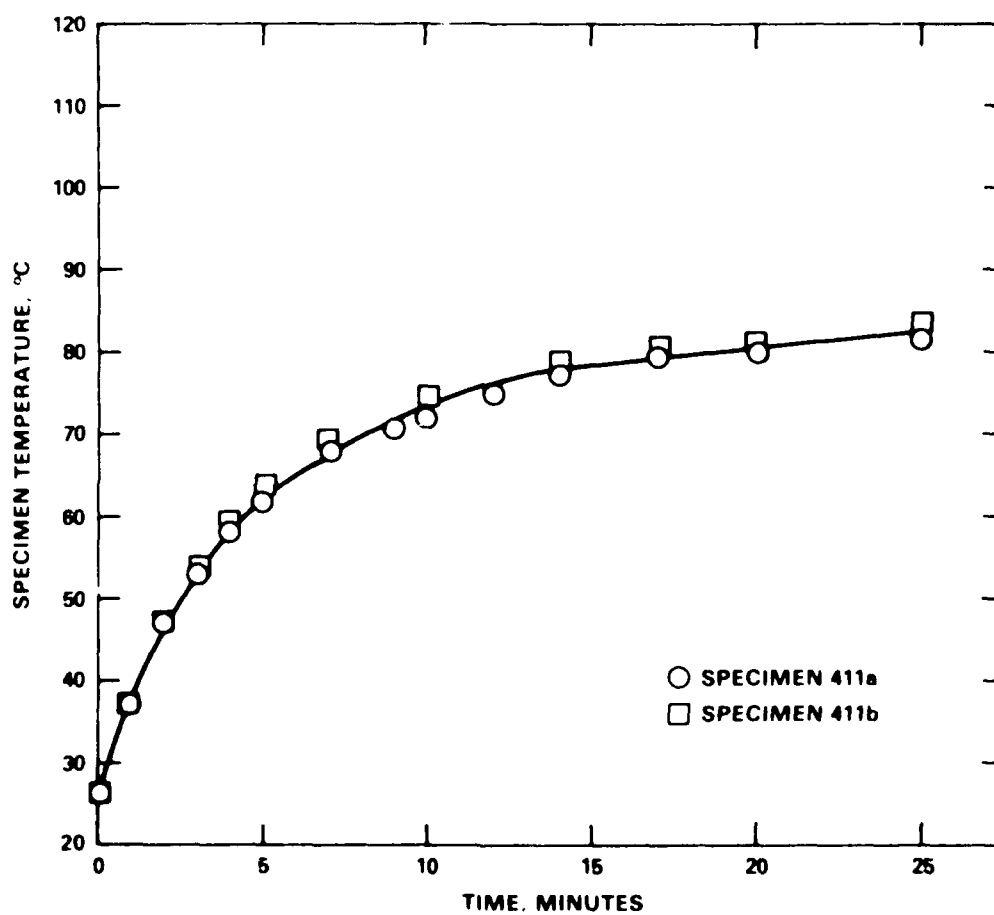
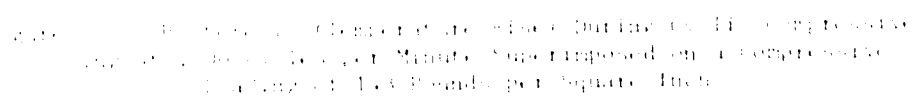


Figure 10-1. Hysteresis Temperature Rise during Cyclic Compressive Loading at 1000 Cycles per Minute Superimposed on a Compressive Load of 143 Pounds per Square Inch



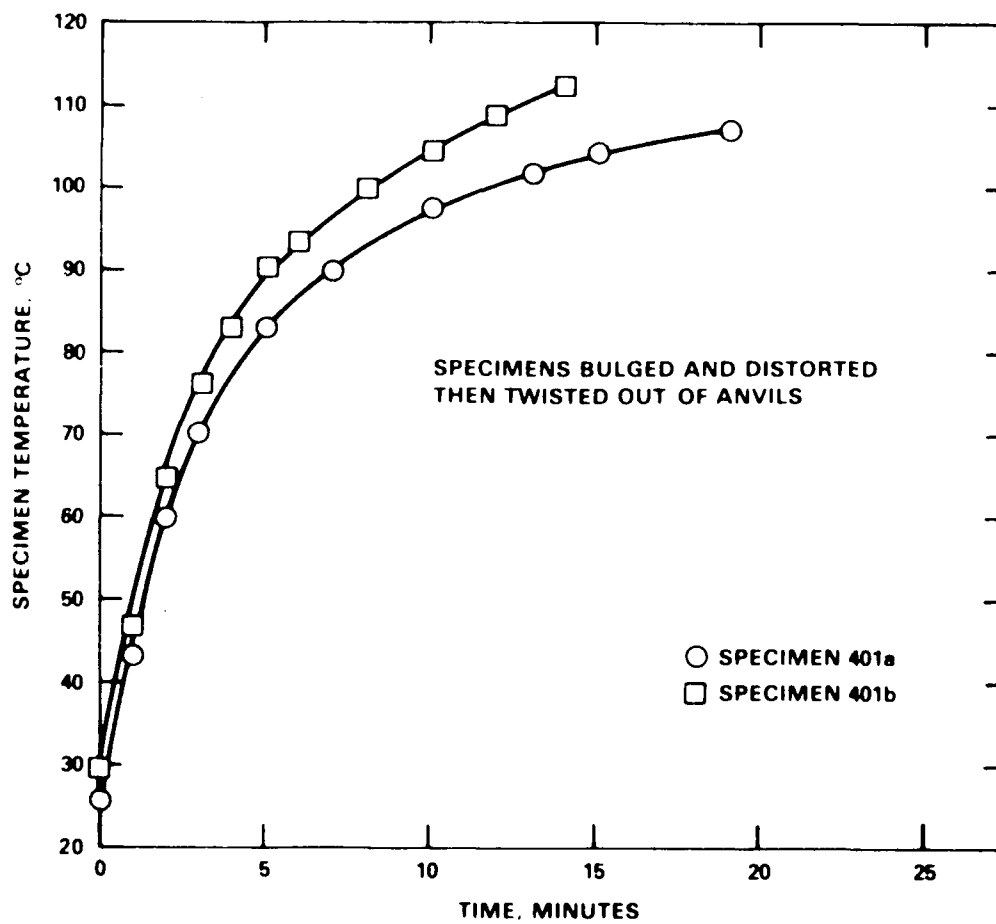


Figure 1. Specimen temperature versus time during cold-chamber compression at 1000 psi per minute. Temperature based on thermocouple readings at 1/4 inch and 1/2 inch per square inch.

Hypalon	E.I. duPont de Nemours & Co., Inc.
Kevlar	Wilmington, DE 19898
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Neoprene GNA	
Neoprene W	
Tetrone A	
Thionex	
Antioxidant 702	Ethyl Corporation
	451 Florida Street
	Baton Rouge, LA 70801
Wingstay 100	Goodyear Tire & Rubber Company
	Chemical Division
	1485 E. Market Street
	Akron, OH 44316
STAN MAG Beads	Harwick Chemical Corporation
	60 S. Seiberling Street
	P.O. Box 9360
	Akron, OH 44305
Parel 58	Hercules Incorporated
Piccopale 100	910 Market Street
	Wilmington, DE 19899
T.12	M&T Chemical Incorporated
	Woodbridge Road
	P.O. Box 1104
	Rahway, NJ 07065
Antioxidant MB	Mobay Chemical Company
Polycarbonate (Desmophen 2020)	Penn Lincoln Parkway West
	Pittsburgh, PA 15205
Santicizer 79TM	Monsanto
Santicizer 711	Rubber Chemicals Division
Santocure	260 Springside Drive
Santocure NS	Akron, OH 44313
Santoflex AW	
Santoguard PVI	
Sulfasan R	
Cumar MH	Neville Chemical Company
	Neville Island
	Pittsburgh, PA 15225
Kadox-15	New Jersey Zinc Company, Inc.
	Palmerton, PA 18071

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Paterson, NJ 07609

Tillamox

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Ayer, MA 01432



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Silane A-1100  
Silane A-1120

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Flexzone 3C  
Rovalene 502  
Sunproof Wax

POP 88

Isonol 100

AgeRite Hipar S  
AgeRite Resin D  
AgeRite Stalite  
AgeRite White  
Altax  
Cumate  
Ethyl Tuads  
Methyl Tuads

Sunolite 666

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